STATUS EVALUATION OF SALMON AND STEELHEAD POPULATIONS IN THE WILLAMETTE AND LOWER COLUMBIA RIVER BASINS

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Willamette/Lower Columbia Technical Recovery Team

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INTRODUCTION

Report Contents

This report describes the results of recent efforts by the Willamette/Lower Columbia Technical Recovery Team (WLC-TRT) and others to evaluate the status of salmon and steelhead populations in the WLC recovery domain. The report is divided into the following parts:

- "Introduction" describes the purpose of the evaluations, the history of the evaluation process, and the groups that participated in the evaluations.
- "Methods" describes the approach to the population evaluations taken by the TRT and others.
- "Results" describes the results of the analyses including individual attribute scores for each population, a comparison of scores among groups, variability among TRT members evaluating the populations, and how different population attributes contribute to the overall population evaluation.
- "Discussion" describes possible interpretations of the population evaluation.
- "Conclusion and Next Steps" provides an overall critique of the process to date and a look at where the project may go in the future.
- Appendix A lists the WLC-TRT and Oregon Department of Fish and Wildlife (ODFW) members who participated in the review of each evolutionarily significant unit (ESU).
- Appendix B describes the population features that contributed to the attribute scores for each population. Appendix B provides a general overview of why each population was scored in a particular way.

Purpose of Evaluation

The purpose of the population evaluation was several-fold. The WLC-TRT developed a method for evaluating population and ESU viability as part of its viability criteria work (McElhany et al. 2003). One purpose of this evaluation was to "test drive" the population status evaluation approach we used in the viability criteria to determine modifications that might be necessary. Another purpose was to inform recovery planning. The viability criteria describe a set of metrics or guidelines for evaluating whether listed ESUs have recovered to the point of viability. For recovery planning, it is useful to understand how a population currently ranks relative to the viability criteria. Knowing the population's current status provides us information on how much improvement is needed for recovery. The current status evaluation also provides information to recovery planners on which of the population's general attributes limit viability.

Although the current status assessment provides some information on the population features limiting recovery, the evaluation was never intended to be an exhaustive look at all specific threats confronting a population. This population status evaluation looks at "higher order" metrics that tend to integrate the consequences of numerous threats. For this population status assessment, we included the following factors: (1) abundance and productivity, (2) diversity, (3) spatial structure, (4) habitat, and, to a lesser extent, (5) juvenile outmigrants (JOM).

Abundance and productivity, for example, are expected to integrate the impacts of a large number of threats such as harvest activity, habitat conditions, interactions with exotic species, etc. We did not examine each individual threat; instead we looked at overall patterns in abundance and productivity that are the result of all these factors. A thorough look at the specific threats is necessary to complete an effective recovery plan.

A stated purpose of the evaluation was to estimate how *far* the current status is from viability. It was not the intent of this effort to estimate how *hard* it would be to get to recovery. The degree of difficulty in achieving viability depends on the specific threats limiting the population and the biological, economic, and socio-political feasibility of addressing them. This feasibility may or may not be correlated with the degree of improvement a population needs to achieve viability.

History of Evaluation Process

The WLC-TRT has been meeting since May 2000. We have focused on population identification and viability criteria issues for Endangered Species Act (ESA) listed salmon and steelhead. The WLC-TRT report on population identification (Myers et al. 2003) describes units we used for the current status evaluations, and the report on viability criteria (McElhany et al. 2003) describes the metrics, standards, and basic approach we used.[1]

The idea of the WLC-TRT evaluating the current status of all WLC salmon and steelhead populations was discussed in spring 2003 by the Broad Sense Recovery Group (BSRG, a working group that consists of members of the WLC-TRT and the Executive Committee for Willamette and Lower Columbia River Salmonid Recovery [Ex Comm]). Both Washington and Oregon subbasin planning participants in the BSRG felt that the evaluation would be useful if completed in a time-frame usable by subbasin planners and a decision was made to move ahead with the project.

In order to make subbasin planning deadlines, in June 2003 a group of three biologists working with the Lower Columbia Fish Recovery Board (LCFRB) evaluated the status of Washington Lower Columbia River ESU populations. The biologists working with the LCFRB used a protocol similar, but not identical to, the TRT's. The differences between the LCFRB and TRT approaches are discussed in "Methods" (page 3).

In July 2003, the TRT conducted a preliminary evaluation of the Lewis River populations as a pilot project. This led to some refinements of the evaluation process, which were summarized in a memo from the WLC-TRT to the NOAA Fisheries Regional Office (WLC-TRT 2003b).

The WLC-TRT evaluated the current status of populations on the Washington side of the Lower Columbia River ESUs (WLC-TRT 2003a) in November 2003, and on the Oregon side in December (WLC-TRT 2004). Simultaneously, ODFW biologists evaluated Oregon populations using the same approach, although the ODFW reviewers were less familiar with the viability criteria. The WLC-TRT and ODFW members who participated in the evaluation of each ESU are listed in Appendix A. The relationship among evaluations conducted by the three different groups (WLC-TRT, LCFRB, and ODFW) is explored in the "Discussion" section (page 39).

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[1] Both reports are available online at http://www.nwfsc.noaa.gov/trt/trt_wlc.htm.

METHODS

WLC-TRT Method

Details of the WLC-TRT evaluation method are described in the interim report on viability criteria (McElhany et al. 2003) and in the WLC-TRT's clarification/modification memo (WLC-TRT 2003b). This section contains a brief overview of the approach.

For the evaluation, populations were ranked for absolute extinction risk on a scale of 0 to 4. The extinction risks associated with each value on the 0–4 scale are shown in Table 1. It is important to note that the persistence categories (0–4) do not represent a linear scale. For example, the persistence probability associated with category 0 has a much greater range (0–40%) than category 4 (> 99%). Extinction risk is the complement of persistence probability (i.e., extinction risk = 1 – persistence probability), and both terms are used in this report.

Table 1. Extinction risk associated with each population persistence category.*

Population persistence category	Probability of population persistence in 100 years	Description
0	0–40%	Either extinct or very high risk of extinction.
1	40–75%	Relatively high risk of extinction in 100 years.
2	75–95%	Moderate risk of extinction in 100 years.
3	95–99%	Low (negligible) risk of extinction in 100 years (viable salmonid population).
4	>99%	Very low risk of extinction in 100 years.

Source: From McElhany et al. (2003), Table 2.3.

* Throughout this report, the population persistence categories are referred to as population scores.

To estimate population extinction risk, four key attributes were evaluated: (1) abundance and productivity, (2) diversity, (3) spatial structure, and (4) habitat. A fifth population attribute for evaluating risk, JOM growth rate, is part of the WLC-TRT viability criteria, but did not have much impact on the current population evaluations due to lack of data (see WLC-TRT 2003b for discussion). The four main population attributes were evaluated on the same 0–4 risk scale. To obtain the overall population score, individual population attribute scores were integrated using a simple weighted mean; the abundance and productivity scores were weighted at twice the other scores.

Individual attributes were evaluated using criteria the WLC-TRT developed to determine viability (McElhany et al. 2003 and WLC-TRT 2003b). A much-abbreviated version of the attribute criteria is in Appendix B. The attribute criteria do not prescribe exact quantitative standards to be applied to a simply calculated metric. Instead, the attribute criteria describe general threshold conditions for viability, which allows the attribute to be evaluated in the population-specific context. For example, the spatial structure criteria do not set any universal thresholds for the fraction of historically accessible habitat that needs to be accessible for a viable population. Rather, the criteria recognize that the fraction of accessible habitat necessary for a viable population depends on the spatial configuration of the population's watershed. This evaluation approach has the advantage of allowing the consideration of population-specific information, but it has the disadvantage of relying on expert judgment, which is more subjective. It is important in this context not to equate "objective" with "correct." The WLC-TRT approach is based on the premise that an assessment of extinction risk relying partially on an expert judgment integration of the available data is likely to be more accurate than an entirely rigid system that uses inflexible objective thresholds, particularly when the available data are highly variable. This issue is revisited in the "Discussion" section (page 39).

In order to conduct the evaluations, biologists at the Northwest Fisheries Science Center (NWFSC), with the help of others, compiled data available on each attribute for each population. These data included time series of abundance with associated abundance and productivity risk metrics, maps of spatial distribution, tables on hatchery stocking history, analyses of watershed habitat processes, and so on. These data were compiled into population data reports, habitat atlases, and general methods reports (NWFSC 2003a–j). In addition to data provided in the reports, individual TRT members relied on personal knowledge of factors affecting population extinction risk.

The WLC-TRT approach was intended to capture the uncertainty associated with the evaluation process. There are several sources of uncertainty. One source is the uncertainty of a given TRT member in deciding the appropriate risk score for a given attribute for a particular population. This uncertainty was captured in two ways. The first was the inclusion of a "data quality" value with each attribute evaluation. The data quality score also ranged from 0 to 4: 0 indicated no confidence that the available data were informative regarding the extinction risk associated with the attribute, and 4 indicated total confidence that the extinction risk could be accurately determined from the available data. The second way that uncertainty was captured was to allow each TRT member to describe the distribution of possible extinction risks associated with each attribute, rather than simply the risk they considered most likely. Each TRT member was given ten "certainty points" to distribute among the possible risk categories (0–4). If a TRT member was highly confident in the risk associated with a given set of data, they might put all ten points in that risk category. If they were less confident, they may distribute their points over several risk categories.

Another uncertainty results from the different conclusions that different biologists examining the same data reach about extinction risk. The evaluation process did not seek consensus among biologists. The differences in data interpretation are an important part of the information obtained by the evaluation. It is important to know where risk conclusions converge and diverge. Although summary results are often presented as overall averages among biologists, this report attempts to convey the variability among biologists as a key piece of information.

In addition to the weighted average method of integrating the individual attribute scores into an overall population risk score, an overall "gestalt" score for overall population risk was estimated. For this score, the evaluators used professional judgment to integrate the data on individual attributes into an overall score. Comparison of the weighted mean and the gestalt scores provides some check on the weighted mean approach.

Although the WLC-TRT has been working on questions of population and ESU viability for over 3 years, the population evaluations themselves occurred very quickly. The WLC-TRT evaluated the Washington populations over two sequential days in November 2003, then evaluated the Oregon populations on two sequential days in December 2003.[2] ESUs were addressed one at a time during these meetings. The TRT first briefly reviewed the data reports and discussed issues related to each population, key features of the data reports, and any additional relevant information. For the Oregon evaluations, ODFW members provided additional information and commented on the data reports. TRT members did not view the data reports prior to the evaluation meetings. After briefly reviewing the information, TRT members individually scored the populations. After scoring was complete and the scores were tallied, TRT members reviewed the scores but did not revise them. Because of time constraints, the time allocated to discussion and scoring of each population was necessarily brief.

LCFRB Method

The three biologists working with the LCFRB (listed in Appendix A) used the basic approach developed in the WLC-TRT viability report (McElhany et al. 2003), but with some important differences. The LCFRB used the same population attributes and the same 0–4 scoring system. However, there are important differences between the LCFRB and WLC-TRT methods. The LCFRB evaluation occurred prior to the WLC-TRT clarifying memo of July 2003 (WLC-TRT 2003b), which addressed issues the LCFRB raised in its evaluation. Therefore, some assumptions adopted in the July memo that were subsequently used by the TRT were not used in the LCFRB evaluation. Some of the more relevant differences in assumptions are described in the discussion section that compares the differences among groups evaluating the populations. Another fundamental difference of the LCFRB and WLC-TRT methods was capturing uncertainty. Unlike the WLC-TRT, biologists working with the LCFRB used a single consensus score for the population attributes. Thus, there was no clear measure of confidence in the rating of each attribute (there was no distribution of ten points among risk categories) and no measure of variability among evaluators.

Another distinction between the LCFRB and WCL-TRT methods is the use of thresholds for different risk attribute categories. Sensing a lack of specificity in the WLC-TRT's viability criteria, the LCFRB biologists developed and applied a few specific thresholds to determine risk categories for some attributes. For example, the LCFRB used the extinction risk estimated by a single population model (McClure et al. 2002) as the sole determinant of abundance and productivity risk for populations for which this metric was calculated. In contrast, the WLC-TRT examined a number of different abundance and productivity extinction risk metrics and allowed TRT members to weigh the information provided by the different metrics independently in assessing the attribute score. The pros and cons of the different approaches are explored in the "Discussion" section (page 39).

The LCFRB biologists scored all of the Washington Lower Columbia River ESU Chinook salmon, Lower Columbia River ESU steelhead, and Columbia River ESU chum salmon populations in a single day. The time allocated to the discussion and scoring of each population was necessarily brief. The LCFRB did not evaluate Lower Columbia River ESU coho salmon.

[2] The lower and upper gorge populations of some ESUs span the Columbia River. The Washington and Oregon portions of these populations were evaluated separately, and the scores were averaged for some of the subsequent analyses.

ODFW Method

ODFW members applied the same approach the TRT did, using the ten-point distribution method with independent scoring by each ODFW participant. The major distinction between the ODFW scorers and WLC-TRT scorers was prior knowledge. From personal experience, ODFW participants had detailed knowledge of specific populations. However, they were unfamiliar with the WLC-TRT viability criteria, because their only exposure occurred during the two-day Oregon population evaluation meeting.

RESULTS

Tables showing the distribution of attribute scores for all WLC populations are in Appendix B, accompanied by a brief description of the key factors that affected WLC-TRT member scores for each population and attribute. These brief descriptions are not intended to be construed as an exhaustive limiting factors analysis.

Figures 1–6 display the overall average results for all three groups that evaluated the WLC populations and information on the current stratum averages. An application of the stratum averages is described in McElhany et al. (2003, pages 11–15).

The majority of the figures in the results section include only data from the WLC-TRT evaluations. The reasons for this are several-fold. The LCFRB evaluation used a single consensus score for each attribute, so analyses that explore individual confidence and among individual variability are not possible. The ODFW participants used the same approach as the WLC-TRT, so the uncertainty analysis is possible. However, we decided to dedicate the majority of our limited time to exploring WLC-TRT scores, which allows for comparison of populations on both sides of the Columbia. If time permits, it would be interesting to conduct similar analyses of the ODFW scores.

Figures 7–11 show the average viability scores for each TRT member for each population. These figures indicate the extent of variability among TRT members in the evaluations. An even greater indication of the uncertainty and variability in the evaluations can be seen in Figures 12–16. These multi-panel figures show the distribution of certainty points for a number of population attributes. These figures are provided as examples, since a complete set of figures for all populations would make the report excessively long. Figures 12 and 13 look at the distribution of the gestalt score for different populations occupying the same basin. Figure 14 shows the distribution for all attributes of a population with a viability score in the middle range of all populations scored (North Santiam steelhead, with average viability score of 1.45). Figure 15 shows the distribution for all the attributes of the population with the highest viability score (Lewis River bright Chinook salmon, with average viability score of 2.15). Figure 16 shows the distribution for all attributes of a population with one of the lowest viability scores (Scappoose chum salmon, with average viability score of 0.48).

Individual average scores for habitat are presented in Figures 17–21. Figures 22–26 plot the coefficient of variation among individual evaluators for each attribute. This indicates which attributes tend to be the most variable. Figure 27 plots the average abundance and productivity score against the data quality score. It indicates that populations with low data quality never rate a high abundance and productivity score. As indicated in Figure 28, most attribute scores show a positive correlation with the abundance and productivity score. The LCFRB tended to give the populations a higher viability score than the WLC-TRT (Figure 29). The ODFW biologists tended to give the populations higher average viability scores in the low–moderate persistence categories and lower scores in the very low–low categories (Figure 30).

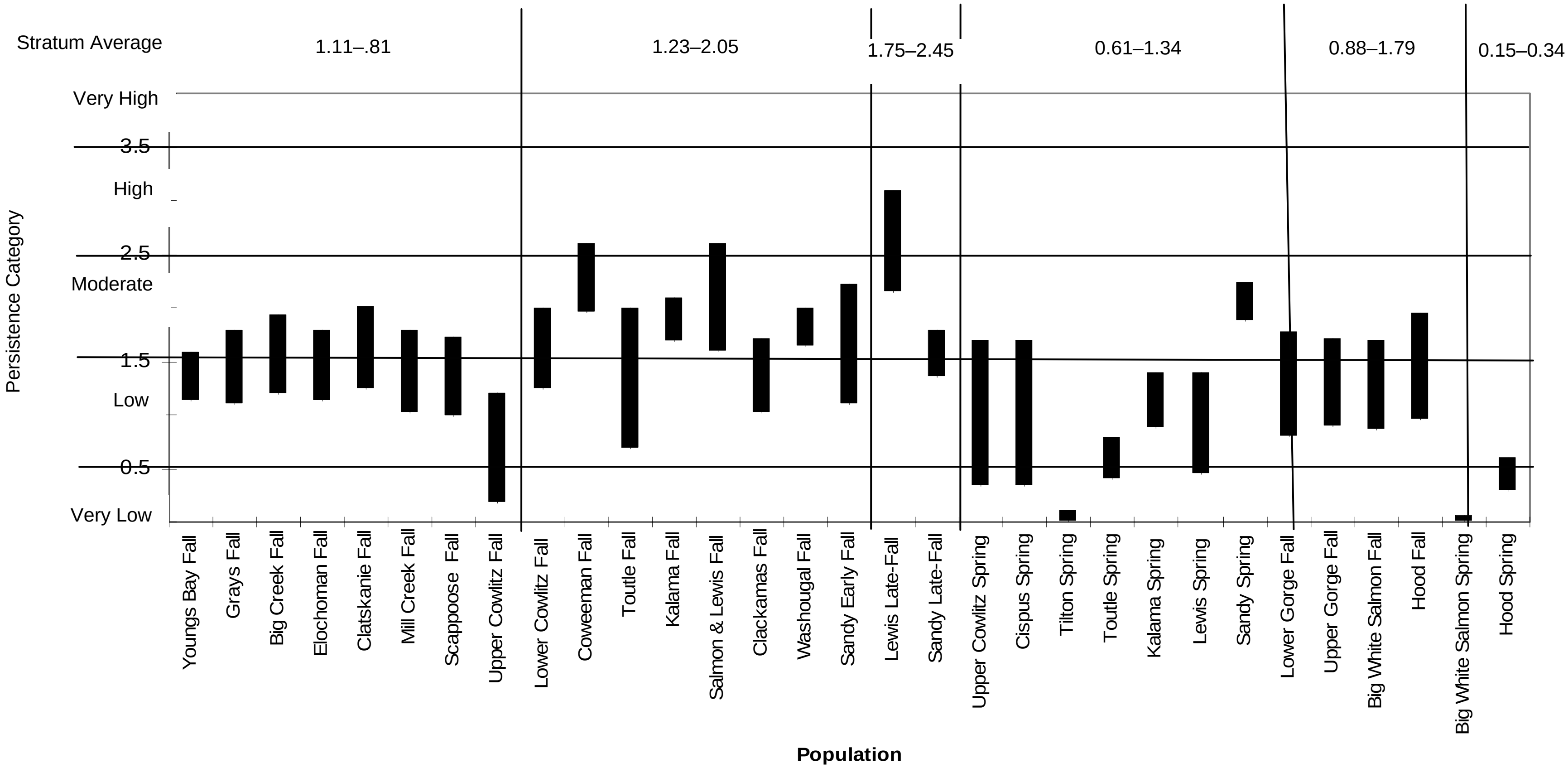


Figure 1. Summary results from the evaluation of current population status for Lower Columbia River ESU Chinook salmon. Populations were evaluated by three different groups: (1) the WLC-TRT, (2) LCFRB, and (3) ODFW. The WLC-TRT and the LCFRB scored the Washington populations; the WLC-TRT and ODFW scored the Oregon populations. Populations were evaluated on a 0–4 scale: 0 = extirpated or nearly so, 4 = very low extinction risk. The bars indicate the range of average scores for the two groups that scored each population. For most populations, the WLC-TRT average scores are the lower of the two values. The vertical lines indicate the different strata. The range of average population scores, by stratum, is presented at the top of the chart. The lower end of the range was calculated by averaging the lowest average population score; the high end was calculated by averaging the highest average population score.

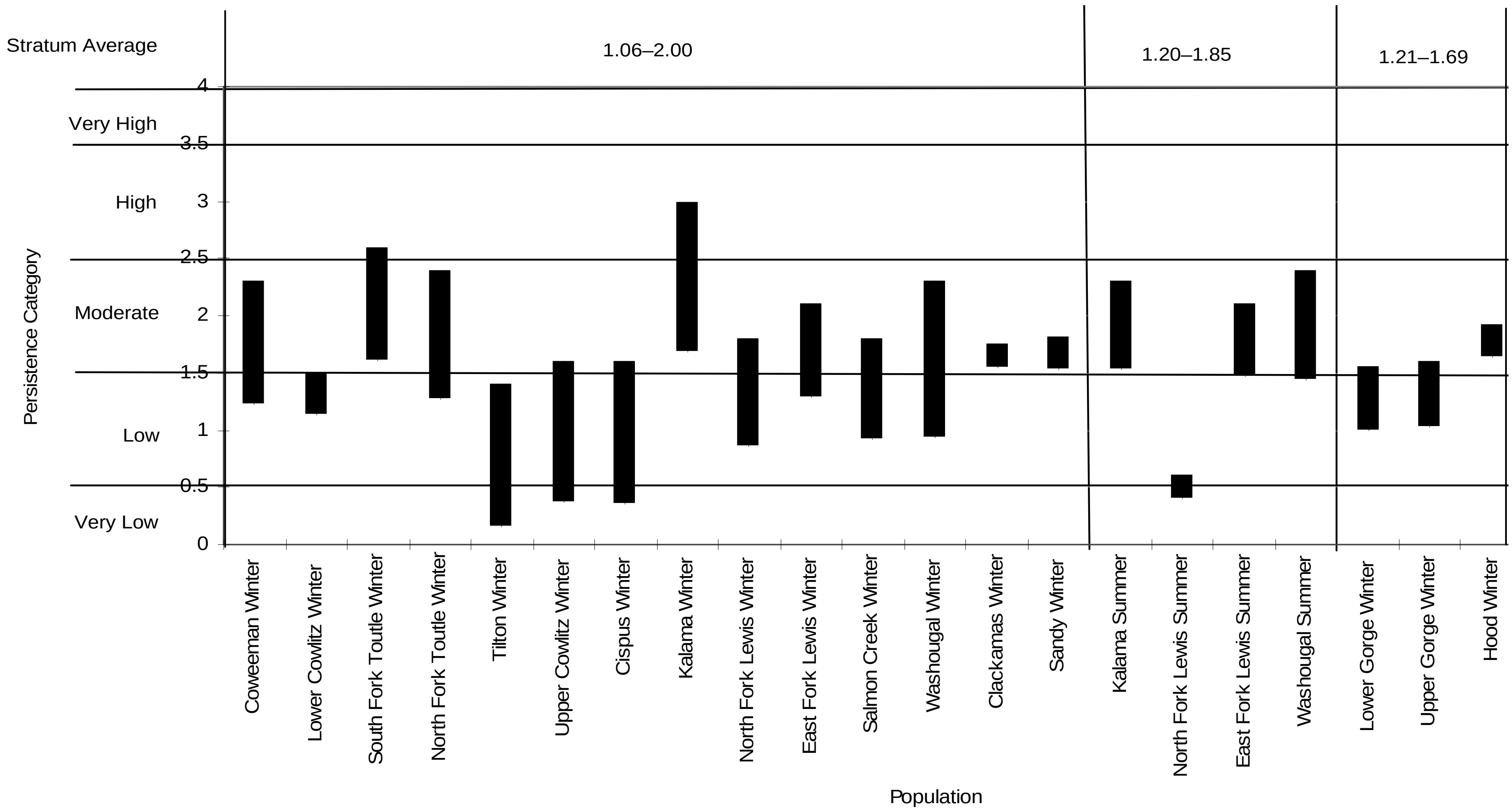


Figure 2. Summary results from the evaluation of current population status for Lower Columbia River ESU steelhead. Populations were evaluated by three different groups: (1) the WLC-TRT, (2) LCFRB, and (3) ODFW. The WLC-TRT and the LCFRB scored the Washington populations; the WLC-TRT and ODFW scored the Oregon populations. Populations were evaluated on a 0–4 scale: 0 = extirpated or nearly so, 4 = very low extinction risk. The bars on the charts indicate the range of the average scores for the two groups that scored each population. For most populations, the WLC-TRT average scores are the lower of the two values. The vertical lines indicate the different strata. The range of average population scores by stratum are presented at the top of the chart. The lower end of the range was calculated by averaging the lowest average population score; the high end was calculated by averaging the highest average population score.

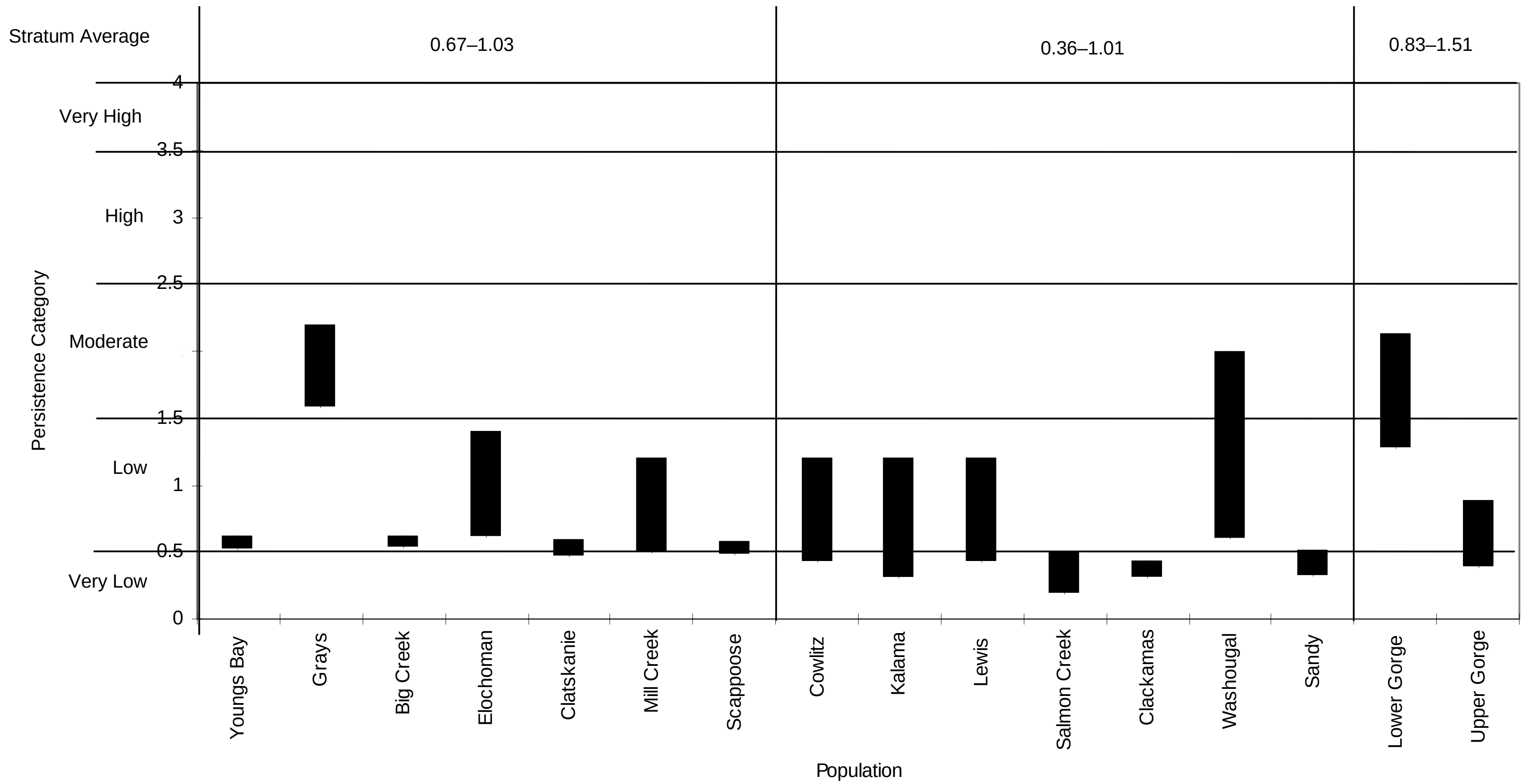


Figure 3. Summary results from the evaluation of current population status for Columbia River chum salmon. Populations were evaluated by three different groups: (1) the WLC-TRT, (2) LCFRB, and (3) ODFW. The WLC-TRT and the LCFRB scored the Washington populations; the WLC-TRT and ODFW scored the Oregon populations. Populations were evaluated on a 0–4 scale: 0 = extirpated or nearly so, 4 = very low extinction risk. The bars indicate the range of the average scores for the two groups that scored each population. For most populations, the WLC-TRT average scores are the lower of the two values. The vertical lines indicate the different strata. The range of average population scores by stratum are at the top. The lower end of the range was calculated by averaging the lowest average population score, and the high end was calculated by averaging the highest average population score.

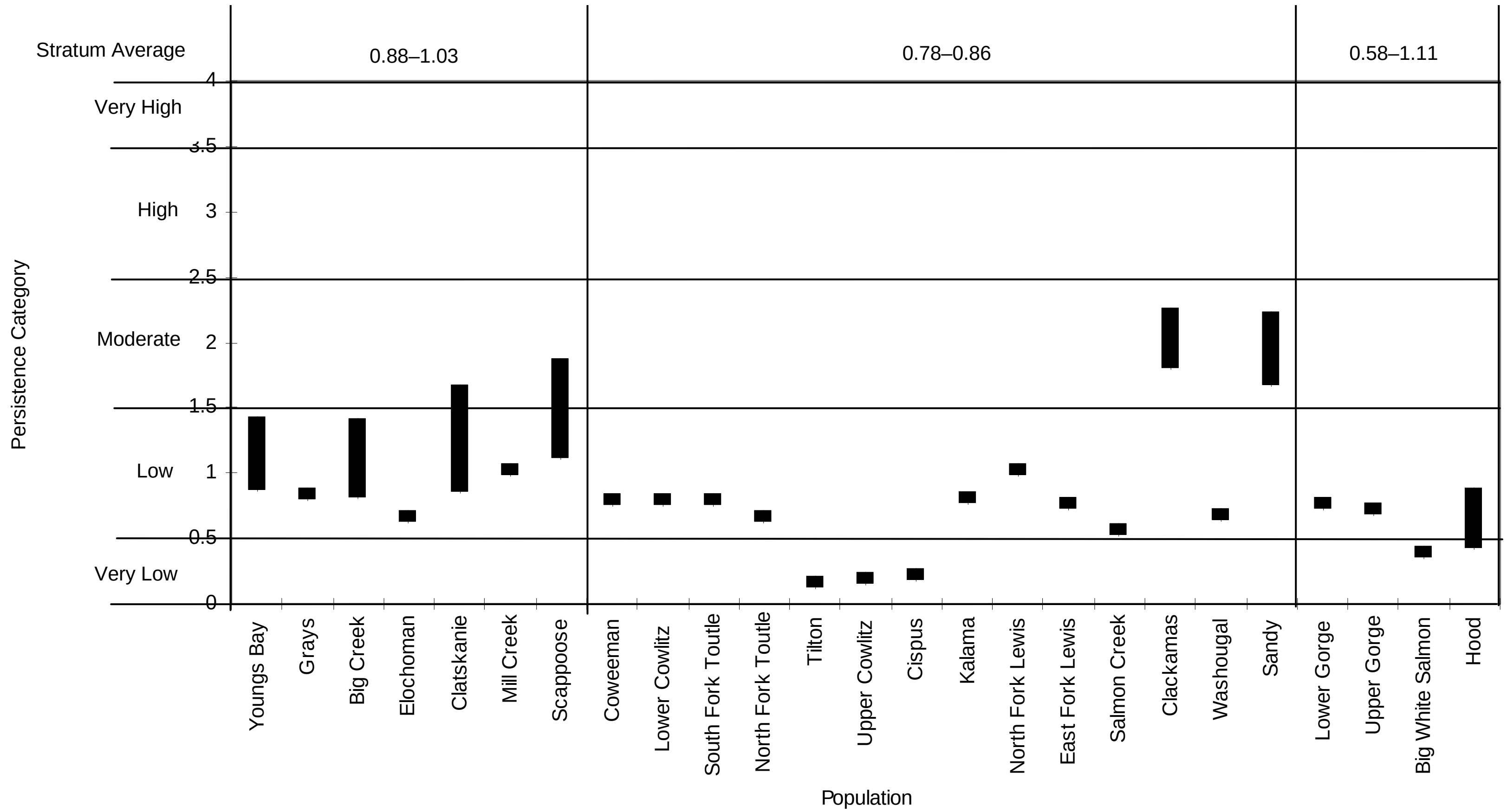


Figure 4. Summary results from the evaluation of current population status for Lower Columbia River ESU coho salmon. The WLC-TRT scored the Washington populations; the WLC-TRT and ODFW scored the Oregon populations. Populations were evaluated on a 0–4 scale: 0 = extirpated or nearly so, 4 = very low extinction risk. The bars indicate the range of the average scores for the two groups that scored each population. For most populations, the WLC-TRT average scores are the lower of the two values. The vertical lines indicate the different strata. The range of average population scores by stratum are at the top of the chart. The lower end was calculated by averaging the lowest average population score; the high end was calculated by averaging the highest average population score.

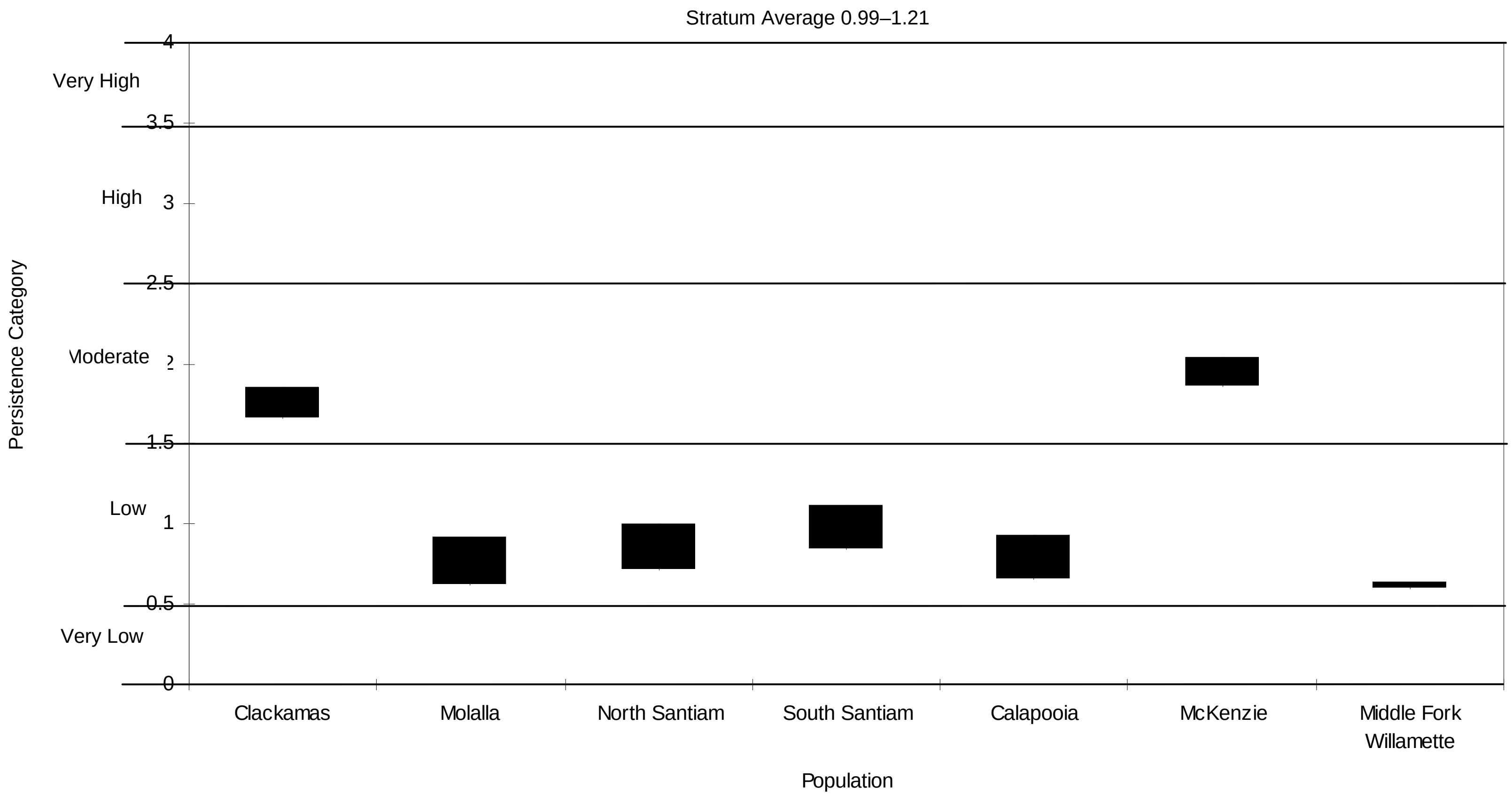


Figure 5. Summary results from the evaluation of current population status for Upper Willamette River ESU Chinook salmon. The WLC-TRT and ODFW scored the populations. Populations were evaluated on a 0–4 scale: 0 = extirpated or nearly so, 4 = very low extinction risk. The bars indicate the range of the average scores for the two groups that scored each population. For most populations, the WLC-TRT average scores are the lower of the two values. The average population scores for the stratum are at the top of the chart. The lower end of the range was calculated by averaging the lowest average population score, and the high end was calculated by averaging the highest average population score.

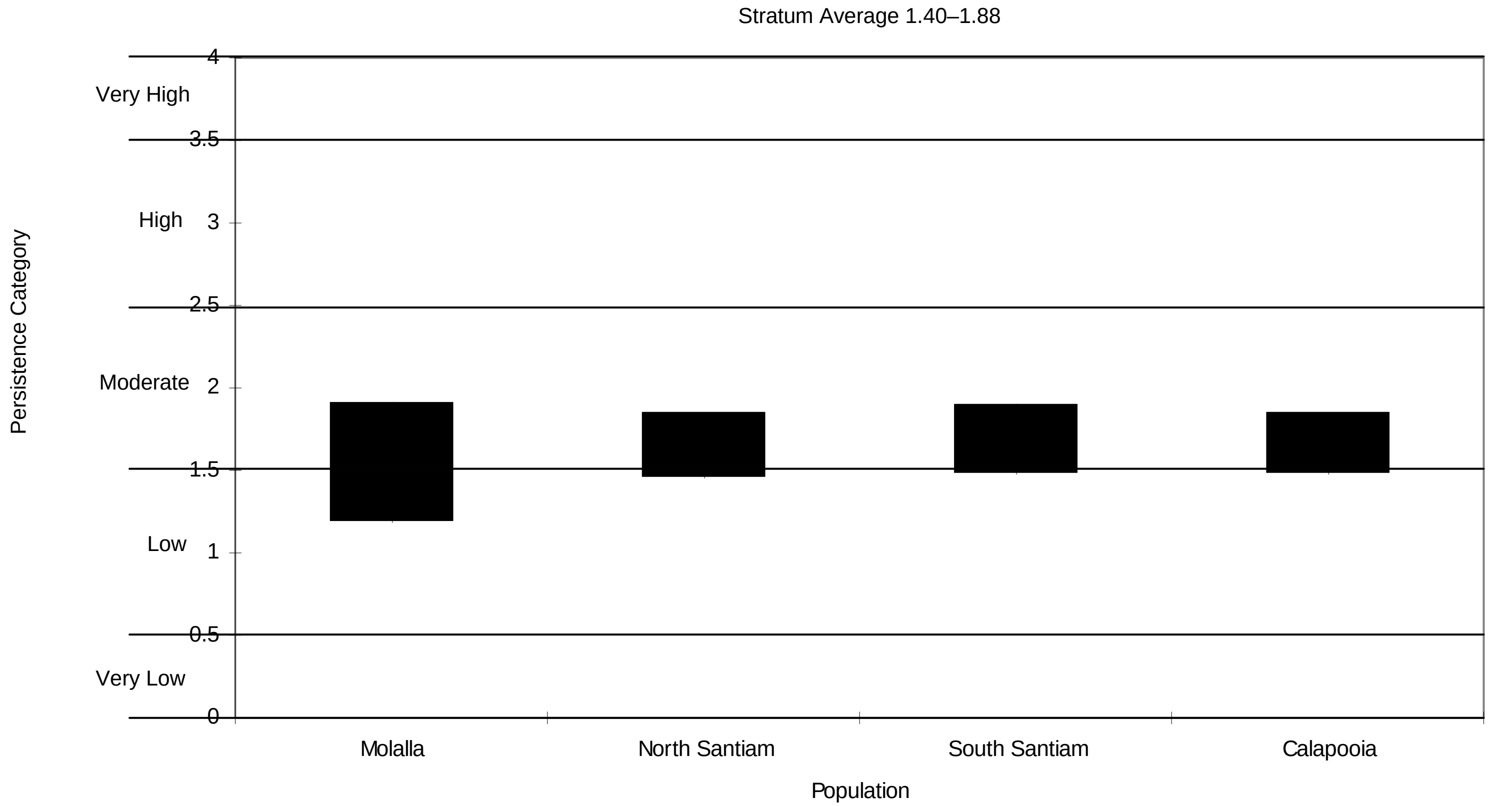


Figure 6. Summary results from the evaluation of current population status for Upper Willamette River ESU steelhead. The WLC-TRT and ODFW scored the populations. Populations were evaluated on a 0–4 scale: 0 = extirpated or nearly so, 4 = very low extinction risk. The bars indicate the range of the average scores for the two groups. For most populations, the WLC-TRT average scores are the lower of the two values. The average population scores for the stratum are at the top of the chart. The lower end of the range was calculated by averaging the lowest average population score, and the high end by averaging the highest average population score.

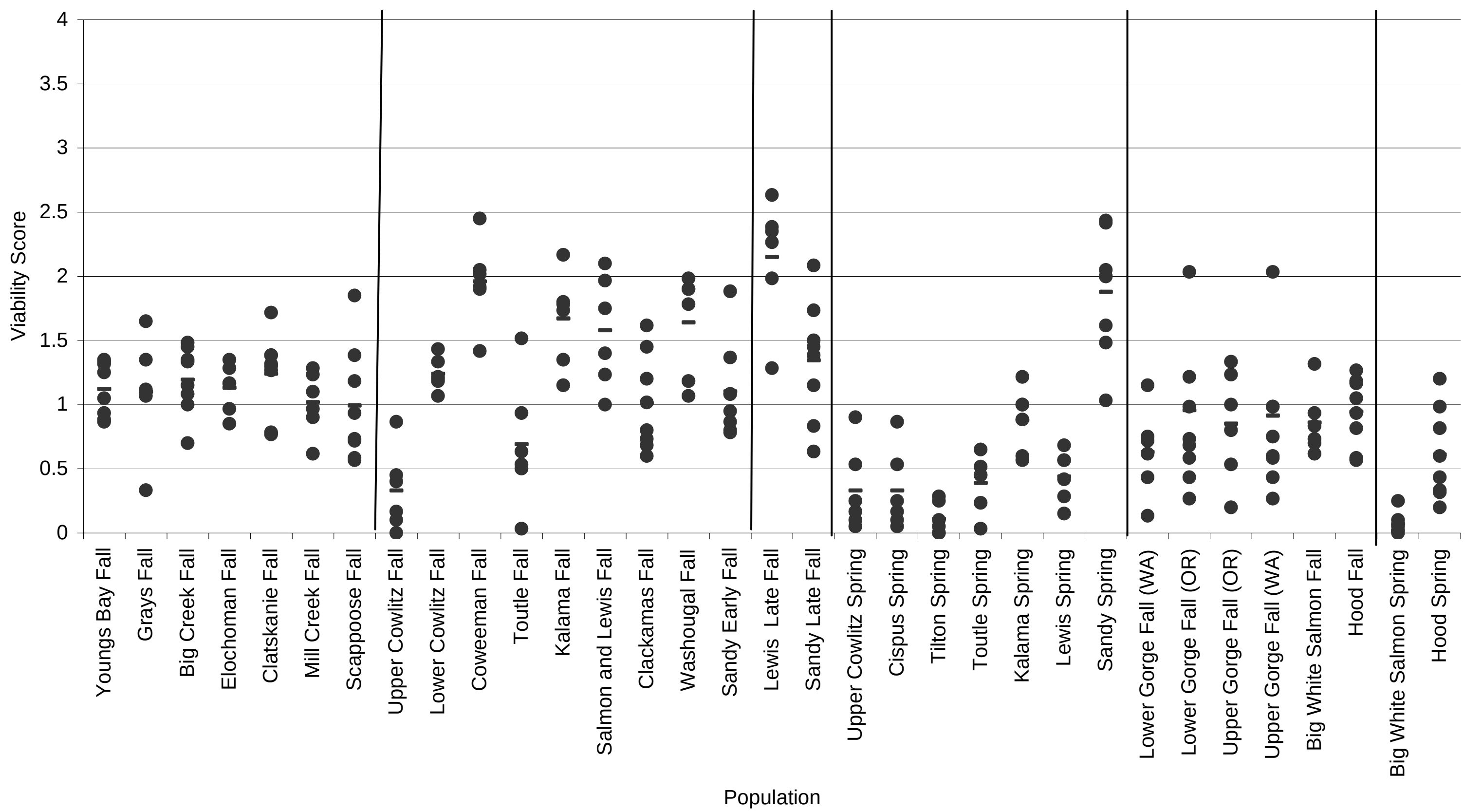


Figure 7. Distribution of average viability scores for individual WLC-TRT members evaluating the current status of Lower Columbia River ESU Chinook salmon populations. The horizontal bar indicates the overall average WLC-TRT score for a particular population. The vertical lines partition different strata. There is a single lower gorge population and a single upper gorge population, but the Washington and Oregon portions of these populations were scored separately for logistical reasons.

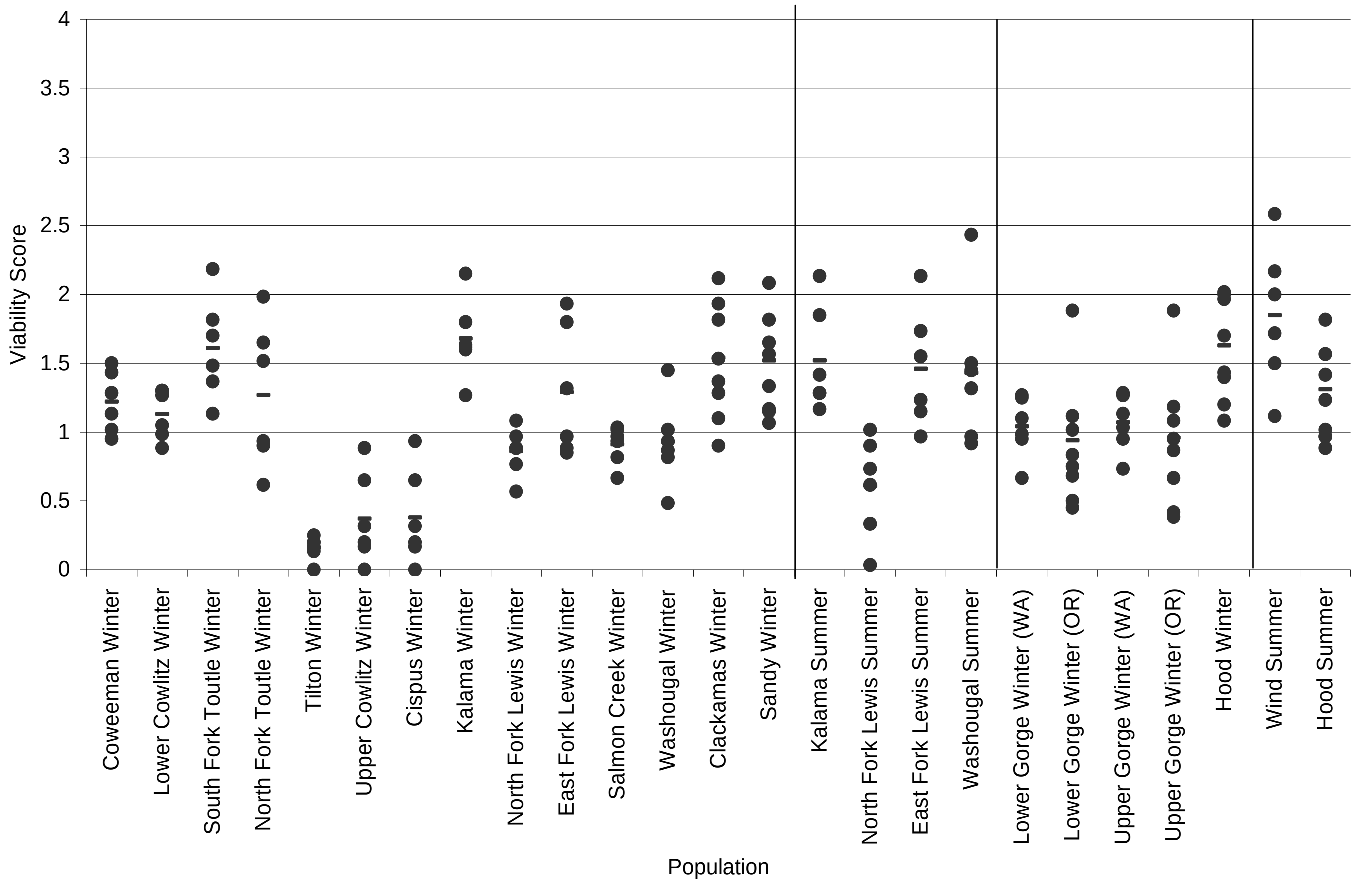


Figure 8. Distribution of average viability scores for individual WLC-TRT members evaluating the current status of Lower Columbia River ESU steelhead populations. The horizontal bar indicates the overall average WLC-TRT score for a particular population. The vertical lines partition different strata. There is a single lower gorge population and a single upper gorge population, but the Washington and Oregon portions of these populations were scored separately for logistical reasons.

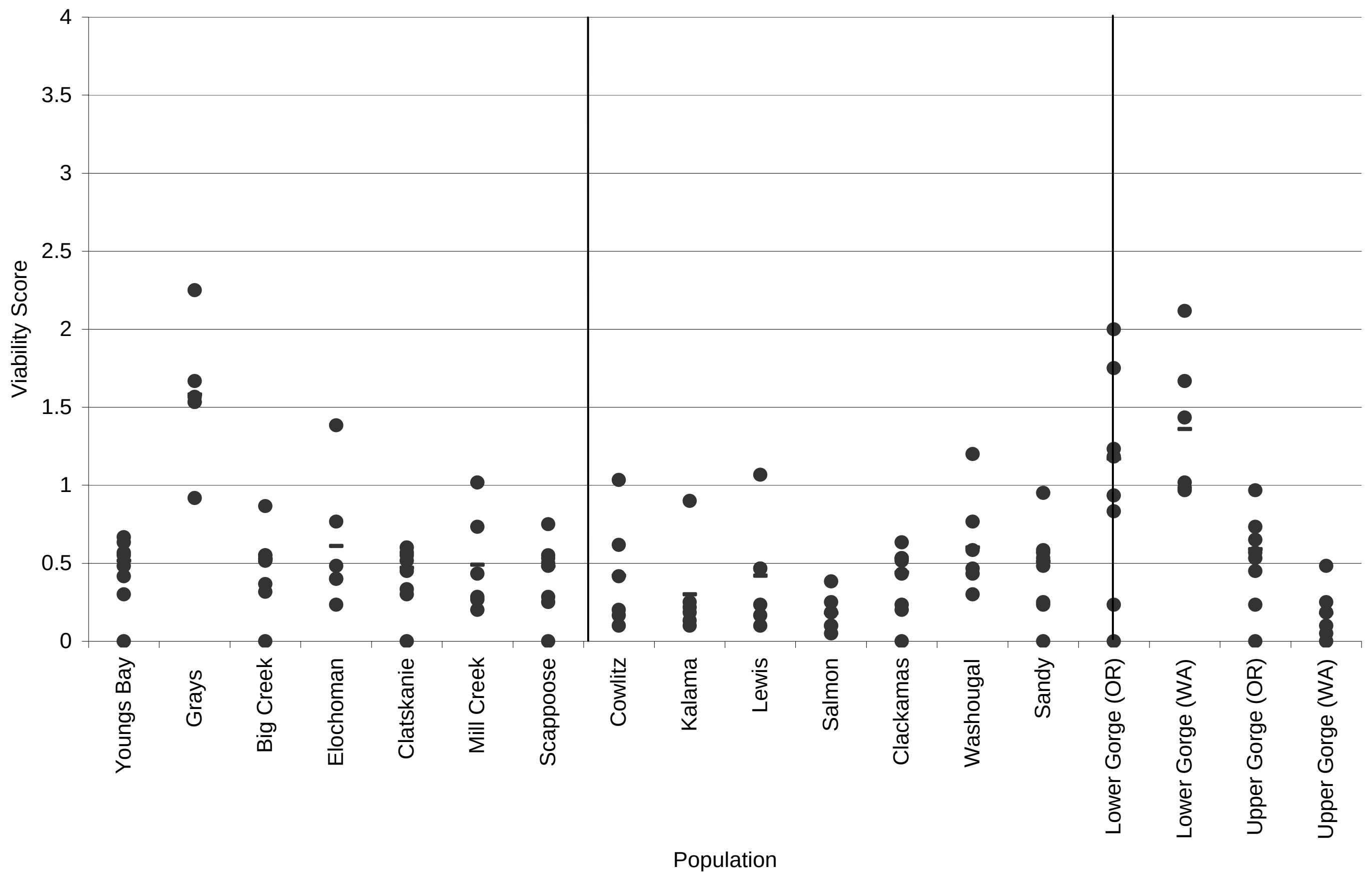


Figure 9. Distribution of average viability scores for individual WLC-TRT members evaluating the current status of Columbia River chum salmon populations. The horizontal bar indicates the overall average WLC-TRT score for a particular population. The vertical lines partition different strata. There is a single lower gorge population and a single upper gorge population, but the Washington and Oregon portions of these populations were scored separately for logistical reasons.

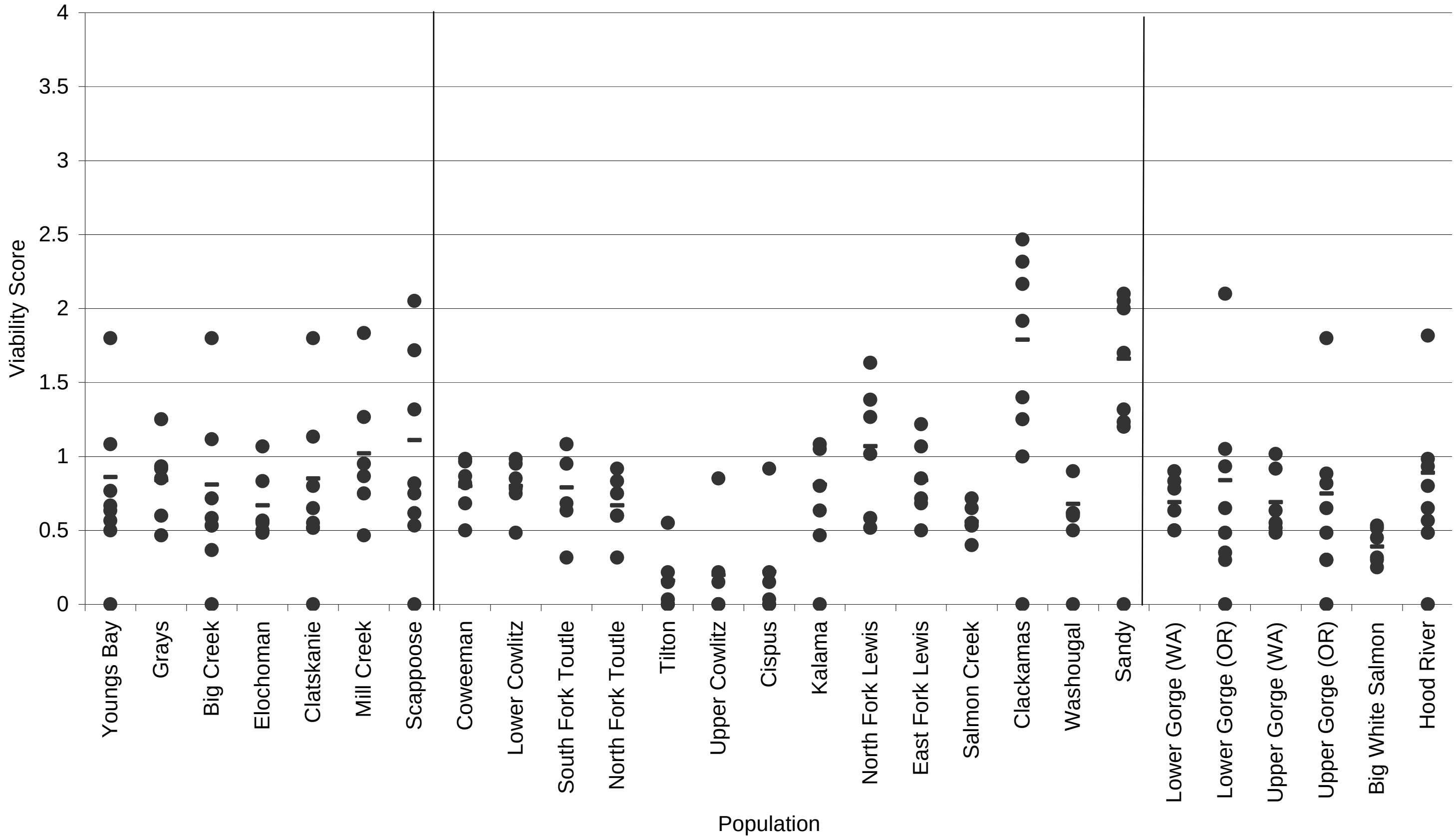


Figure 10. Distribution of average viability scores for individual WLC-TRT members evaluating the current status of Lower Columbia River ESU coho salmon populations. The horizontal bar indicates the overall average WLC-TRT score for a particular population. The vertical lines partition different strata. There is a single lower gorge population and a single upper gorge population, but the Washington and Oregon portions of these populations were scored separately for logistical reasons.

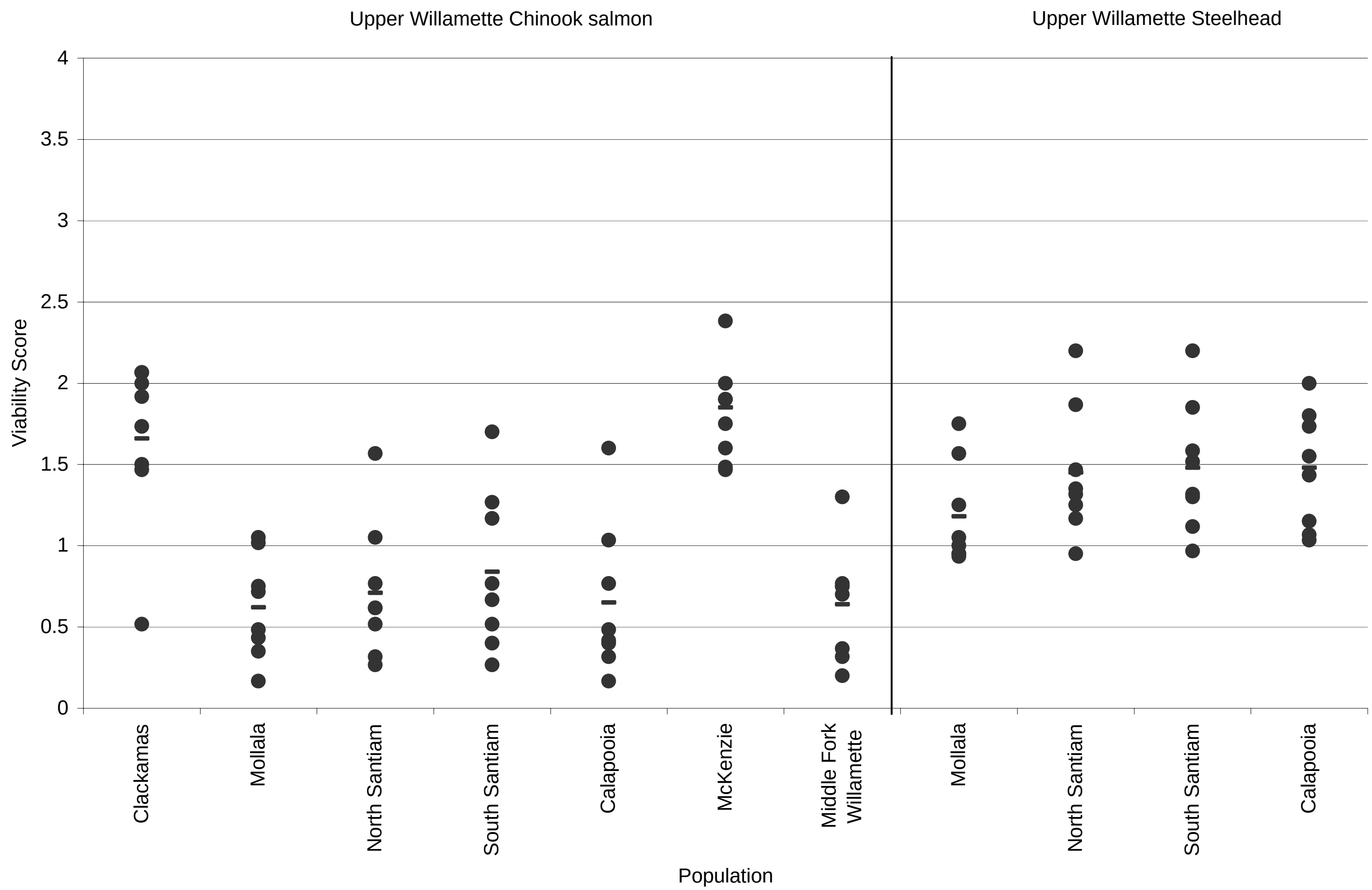


Figure 11. Distribution of average viability scores for individual WLC-TRT members evaluating the current status of Upper Willamette River ESU Chinook salmon and steelhead populations. The horizontal bar indicates the overall average WLC-TRT score for a particular population. The vertical lines partition the two ESUs.

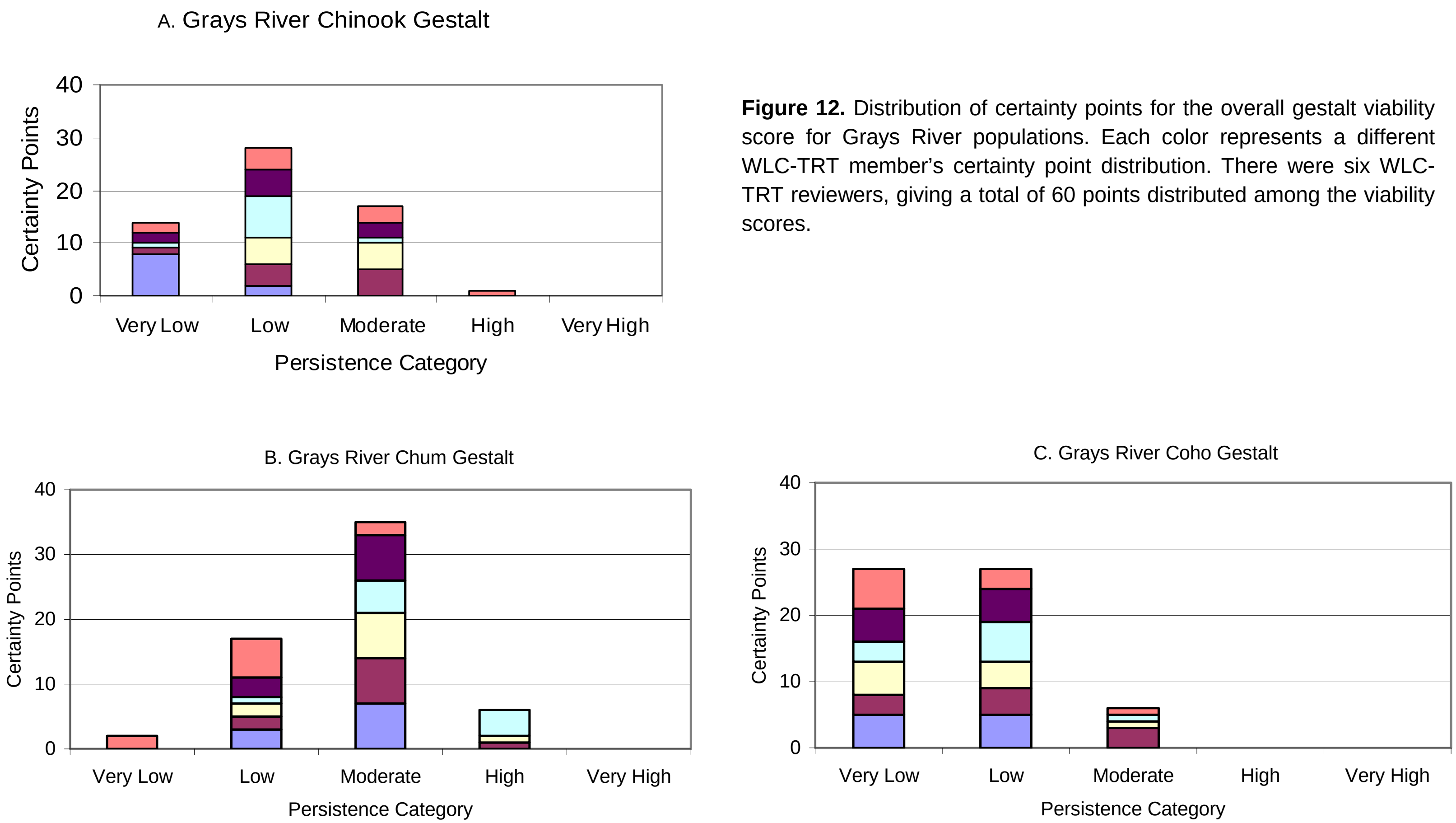


Figure 12. Distribution of certainty points for the overall gestalt viability score for Grays River populations. Each color represents a different WLC-TRT member's certainty point distribution. There were six WLC-TRT reviewers, giving a total of 60 points distributed among the viability scores.

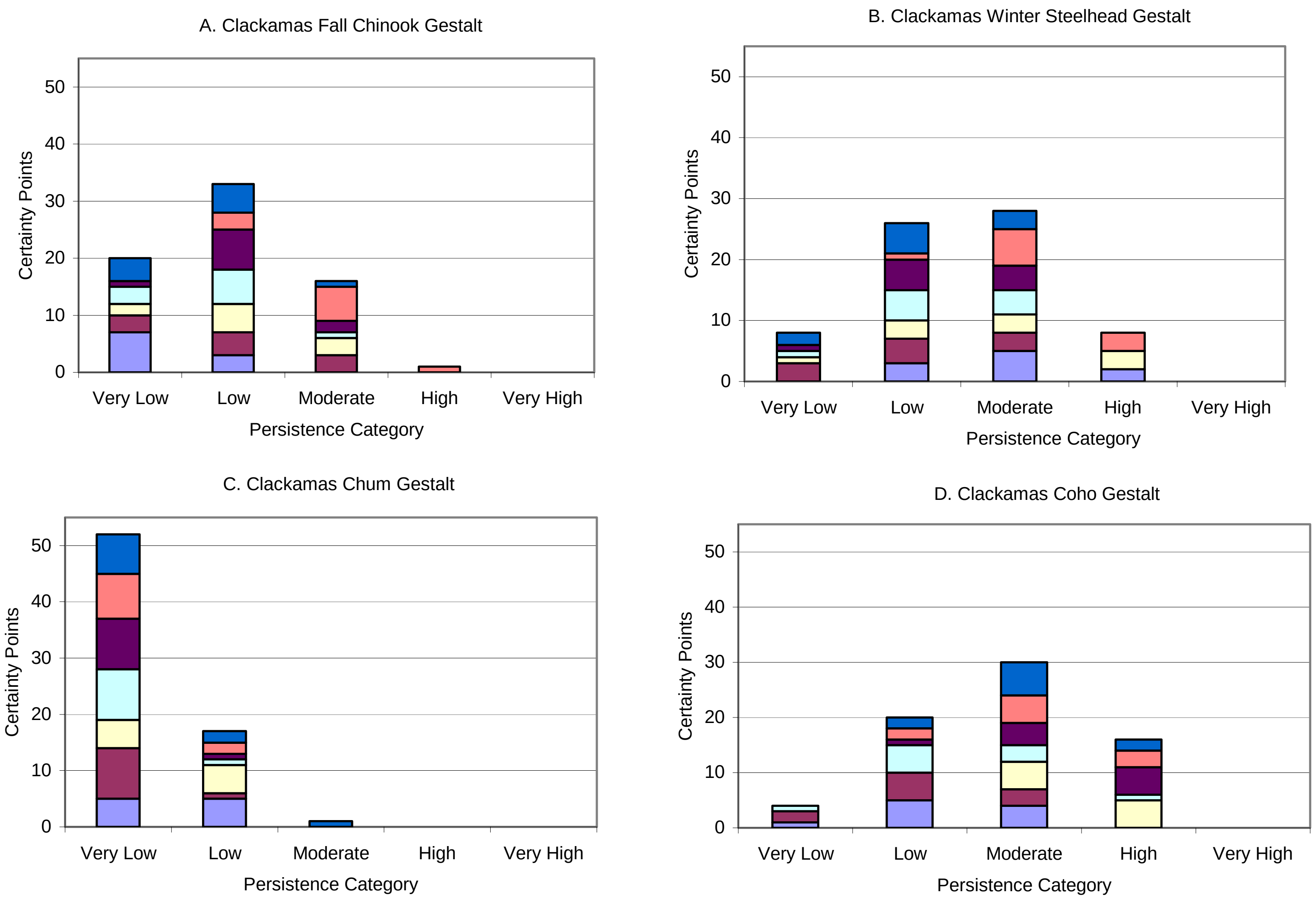
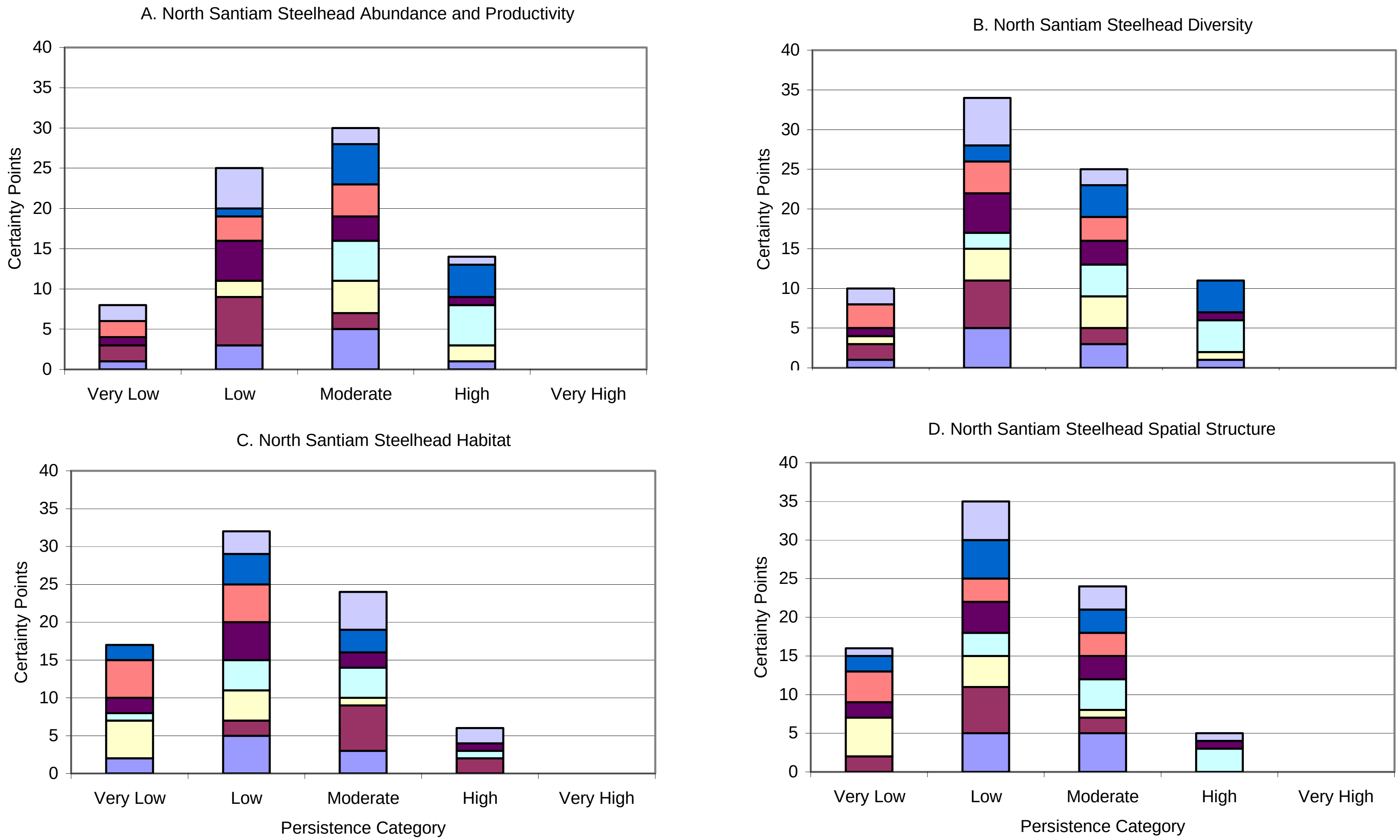


Figure 13. Distribution of certainty points for the overall gestalt viability score for Clackamas River populations. Each color represents a different WLC-TRT member's certainty point distribution. There were seven WLC-TRT reviewers of all four populations, giving a total of 70 points distributed among the viability scores.


A. North Santiam Steelhead Abundance and Productivity
B. North Santiam Steelhead Diversity
C. North Santiam Steelhead Habitat
D. North Santiam Steelhead Spatial Structure
Certainty Points
0
5
10
15
20
25
30
35
40
Very Low
Low
Moderate
High
Very High
Persistence Category

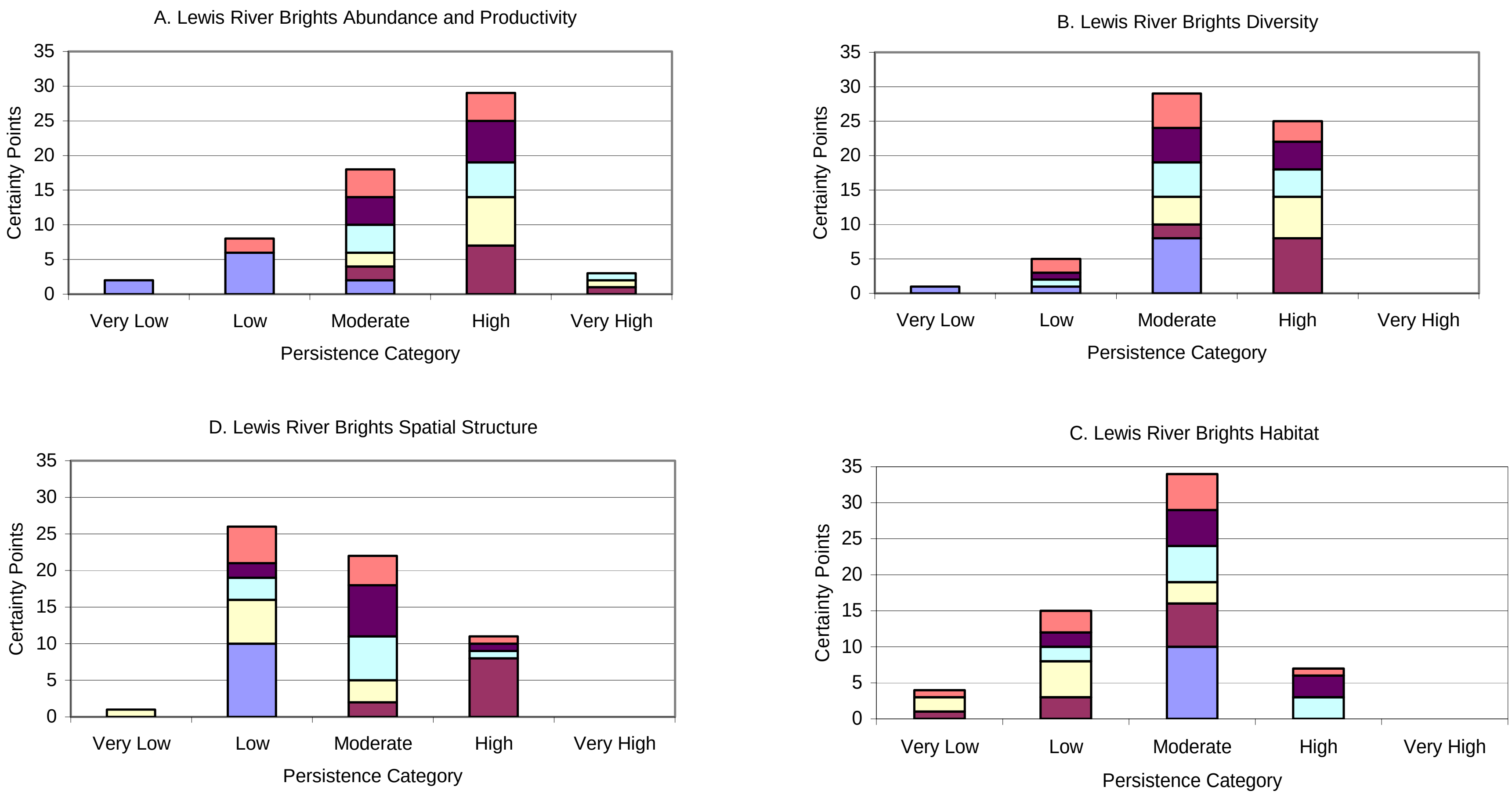
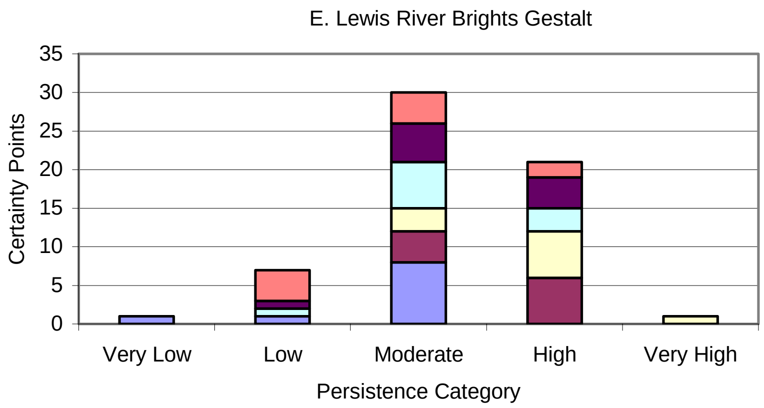
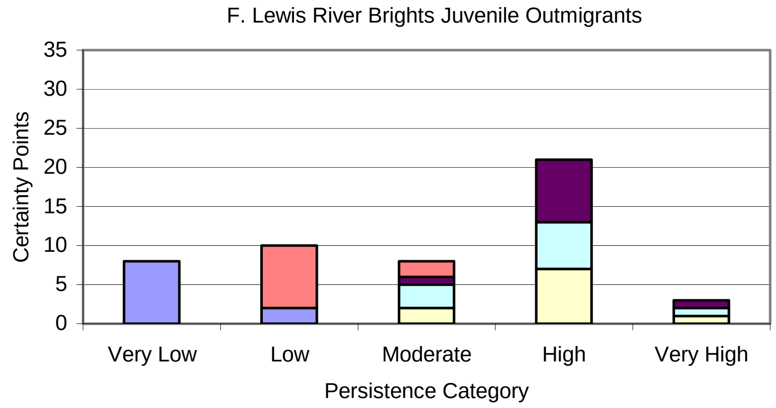


Figure 15. Distribution of certainty points for attributes of the Lewis River bright (late-fall) Chinook salmon population. Each color represents a different WLC-TRT member's certainty point distribution. There were six WLC-TRT reviewers, giving a total of 60 points distributed among the viability scores. Panel G shows the distribution of weighted averages.





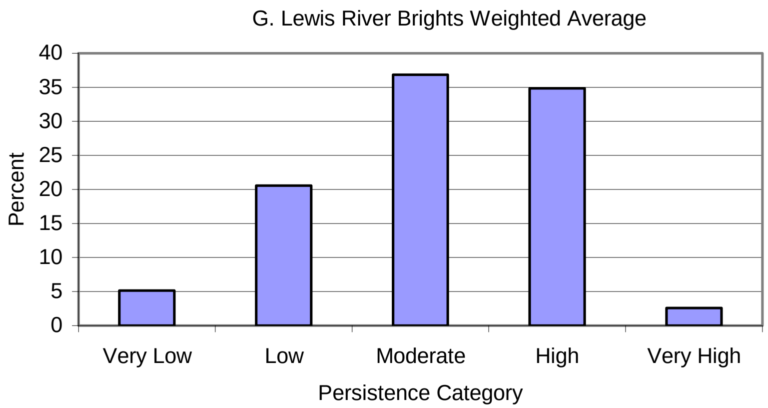


Figure 15 continued.

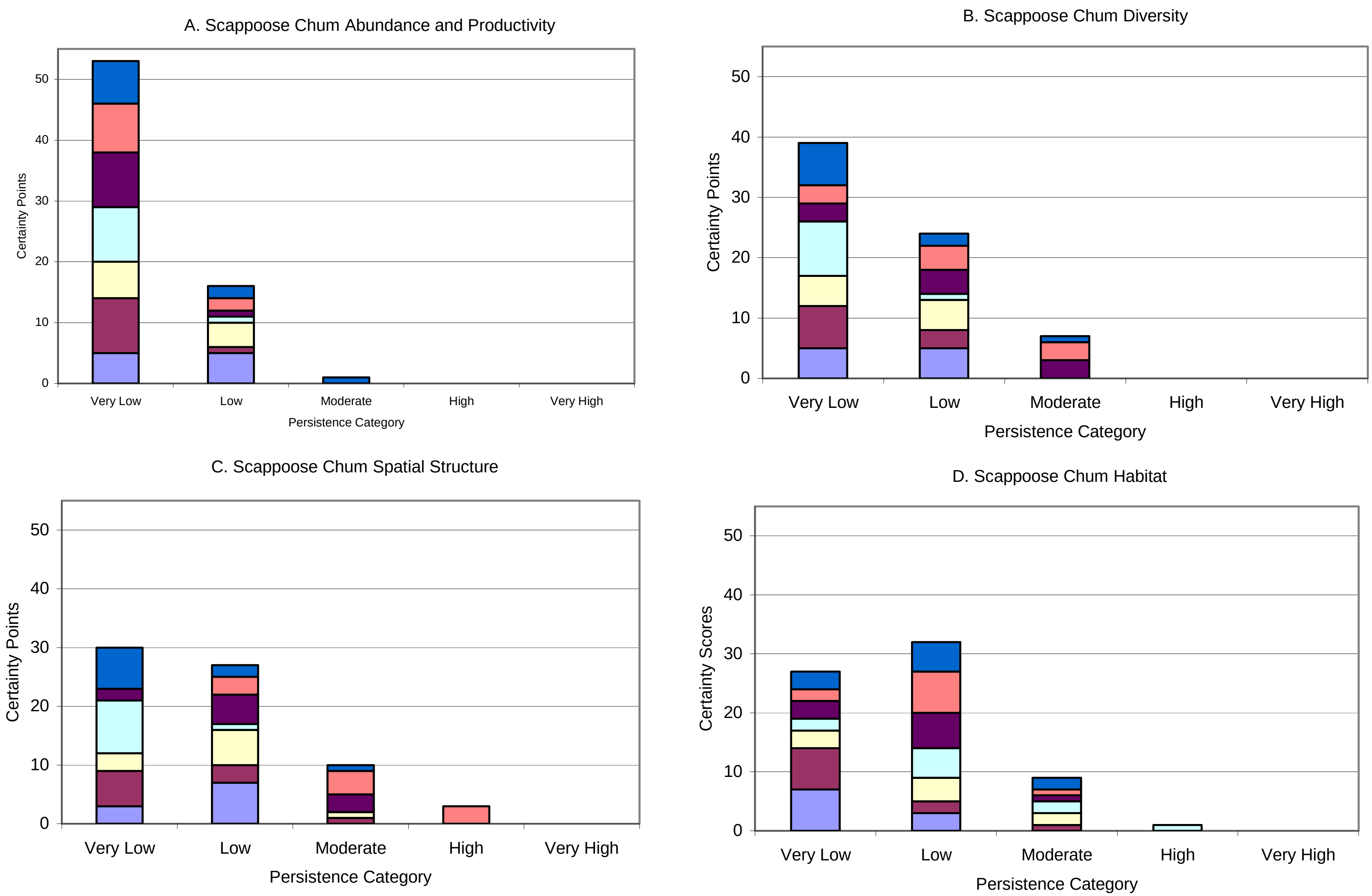


Figure 16. Distribution of certainty points for attributes of the Scappoose River chum salmon population. Each color represents a different WLC-TRT member's certainty point distribution. There were seven WLC-TRT reviewers, giving a total of 70 points distributed among the viability scores.

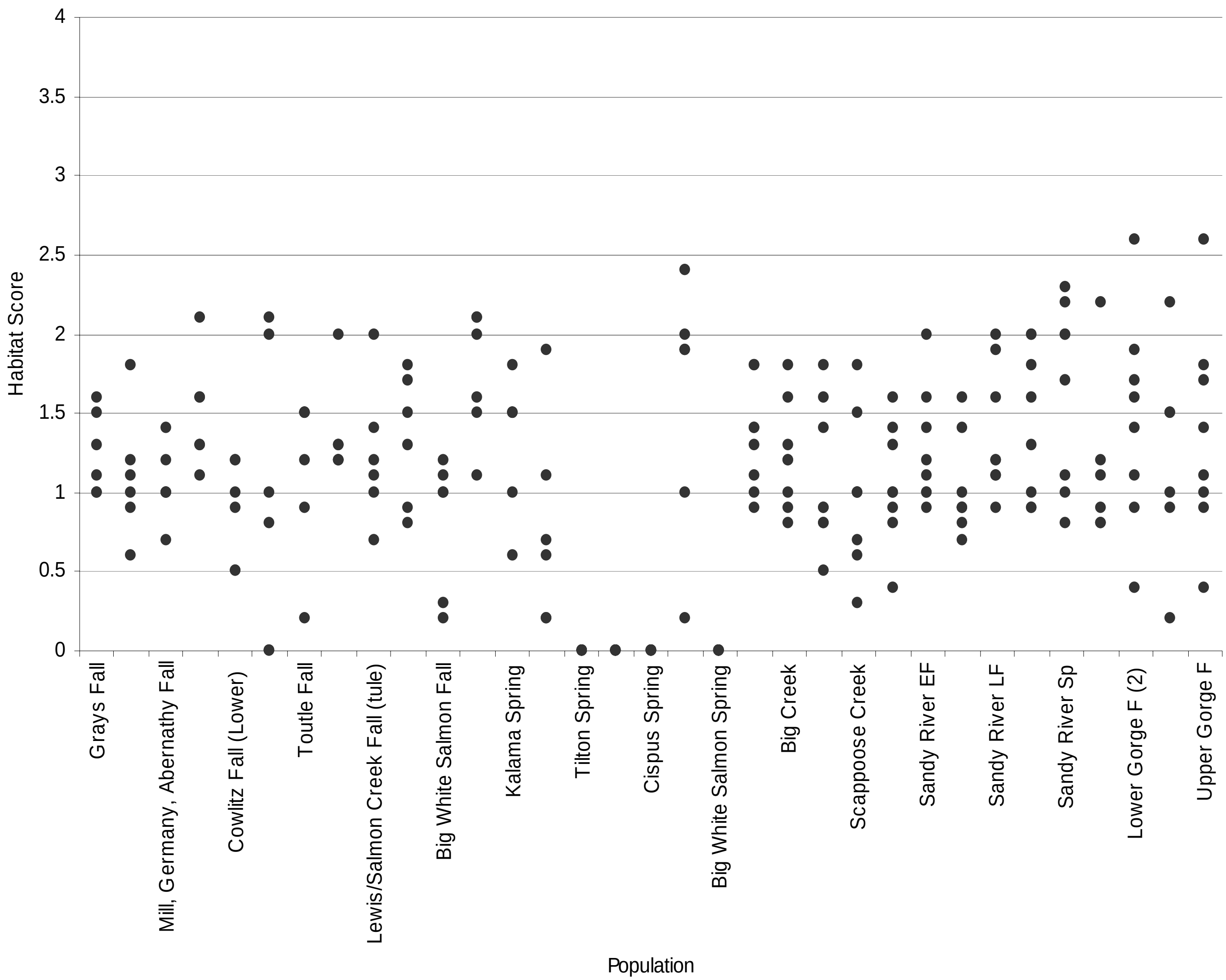


Figure 17. Distribution of average habitat scores for individual WLC-TRT members evaluating the current status of Lower Columbia River ESU Chinook salmon populations.

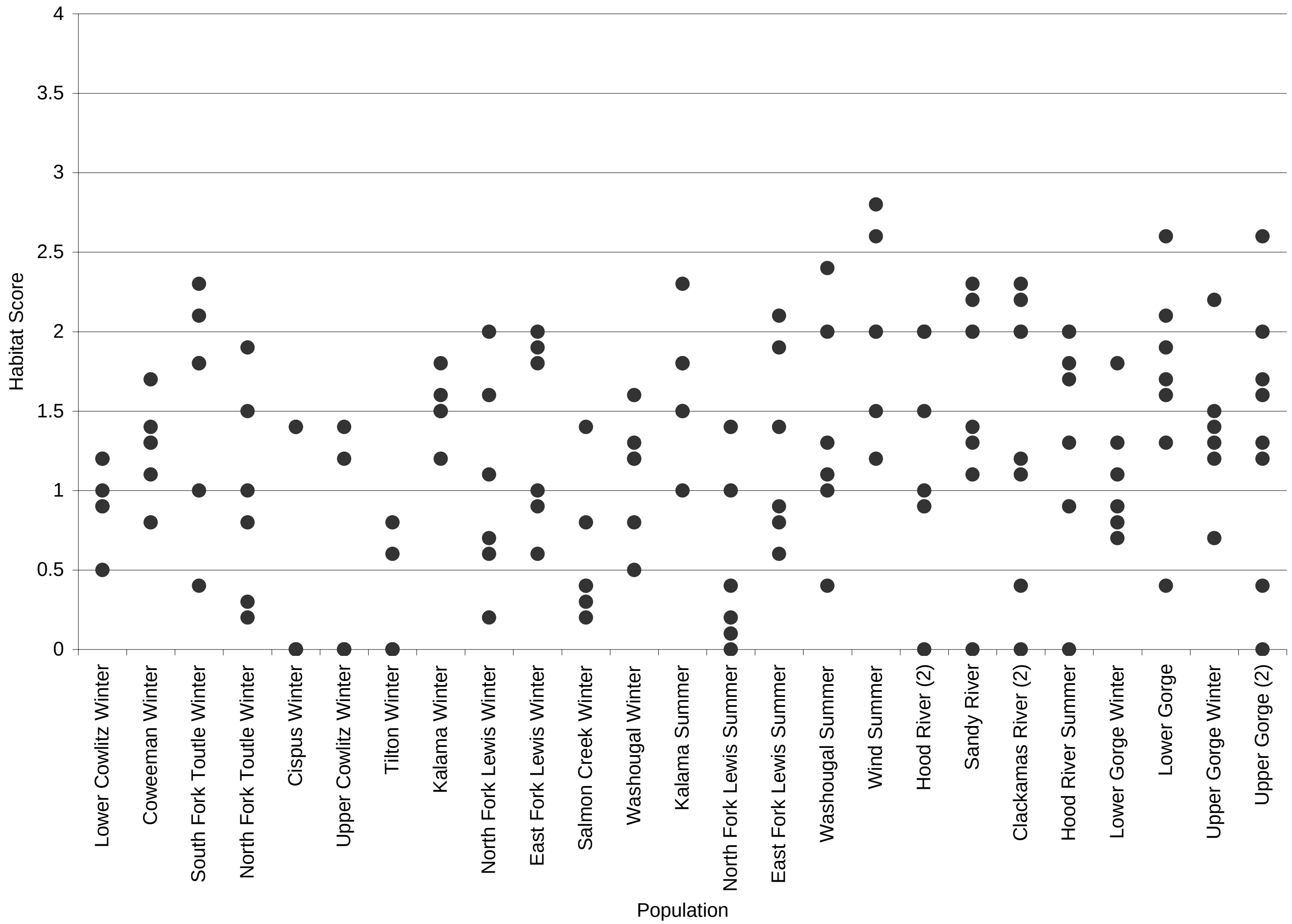


Figure 18. Distribution of average habitat scores for individual WLC-TRT members evaluating the current status of Lower Columbia River ESU steelhead populations.

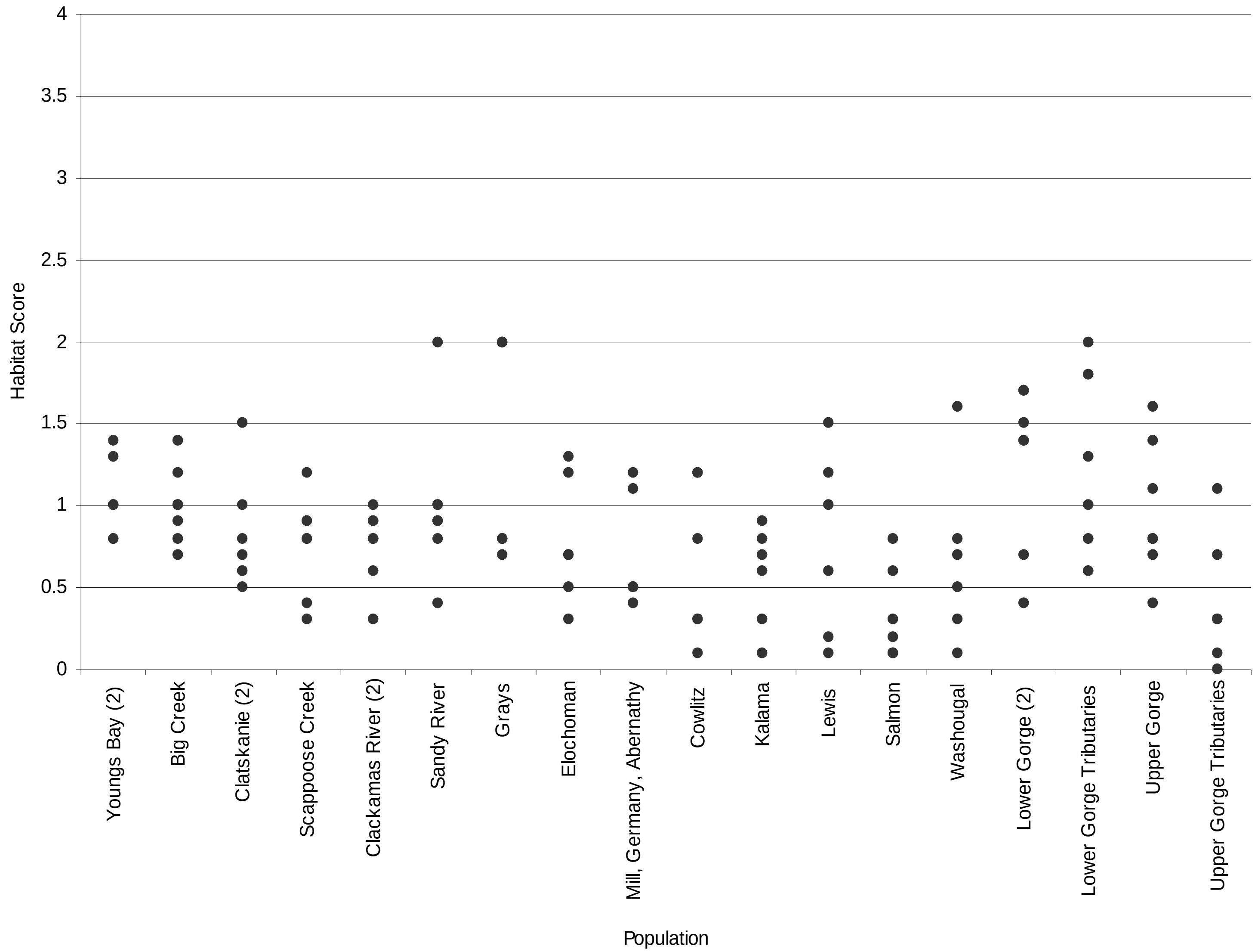


Figure 19. Distribution of average habitat scores for individual WLC-TRT members evaluating the current status of Columbia River chum salmon populations.

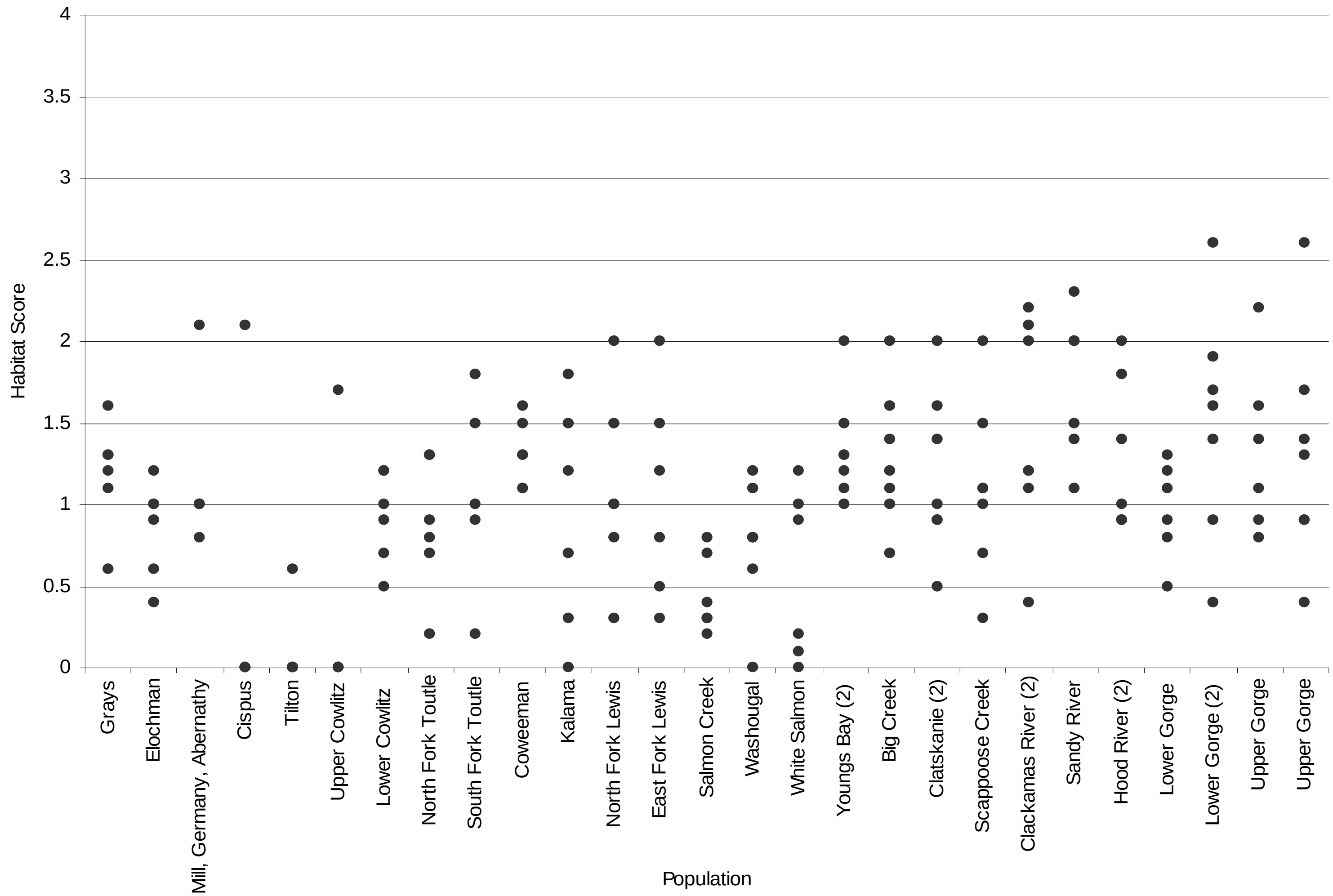


Figure 20. Distribution of average habitat scores for individual WLC-TRT members evaluating the current status of Lower Columbia River coho salmon populations.

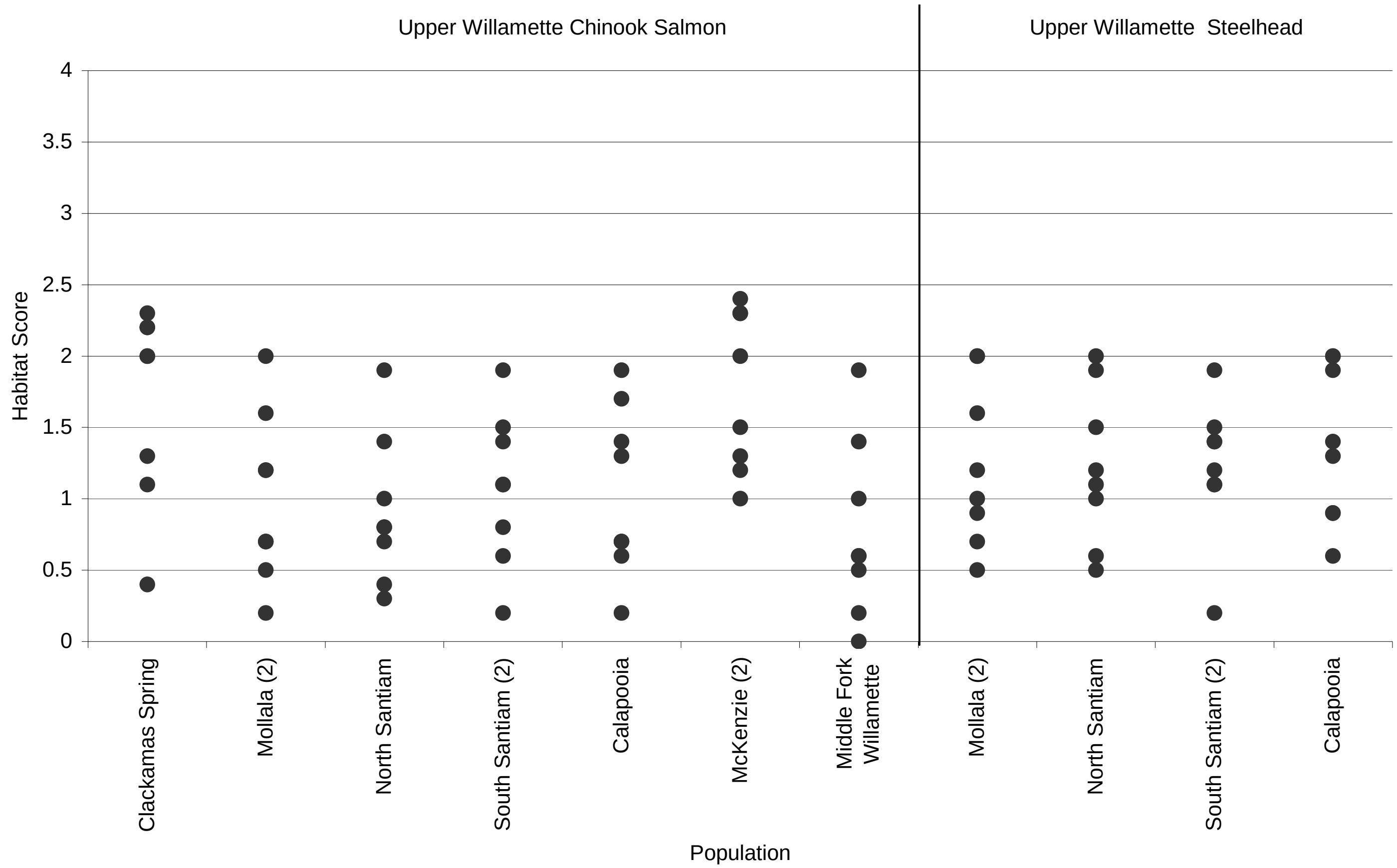


Figure 21. Distribution of average habitat scores for individual WLC-TRT members evaluating the current status of Upper Willamette River ESU Chinook salmon and steelhead populations.

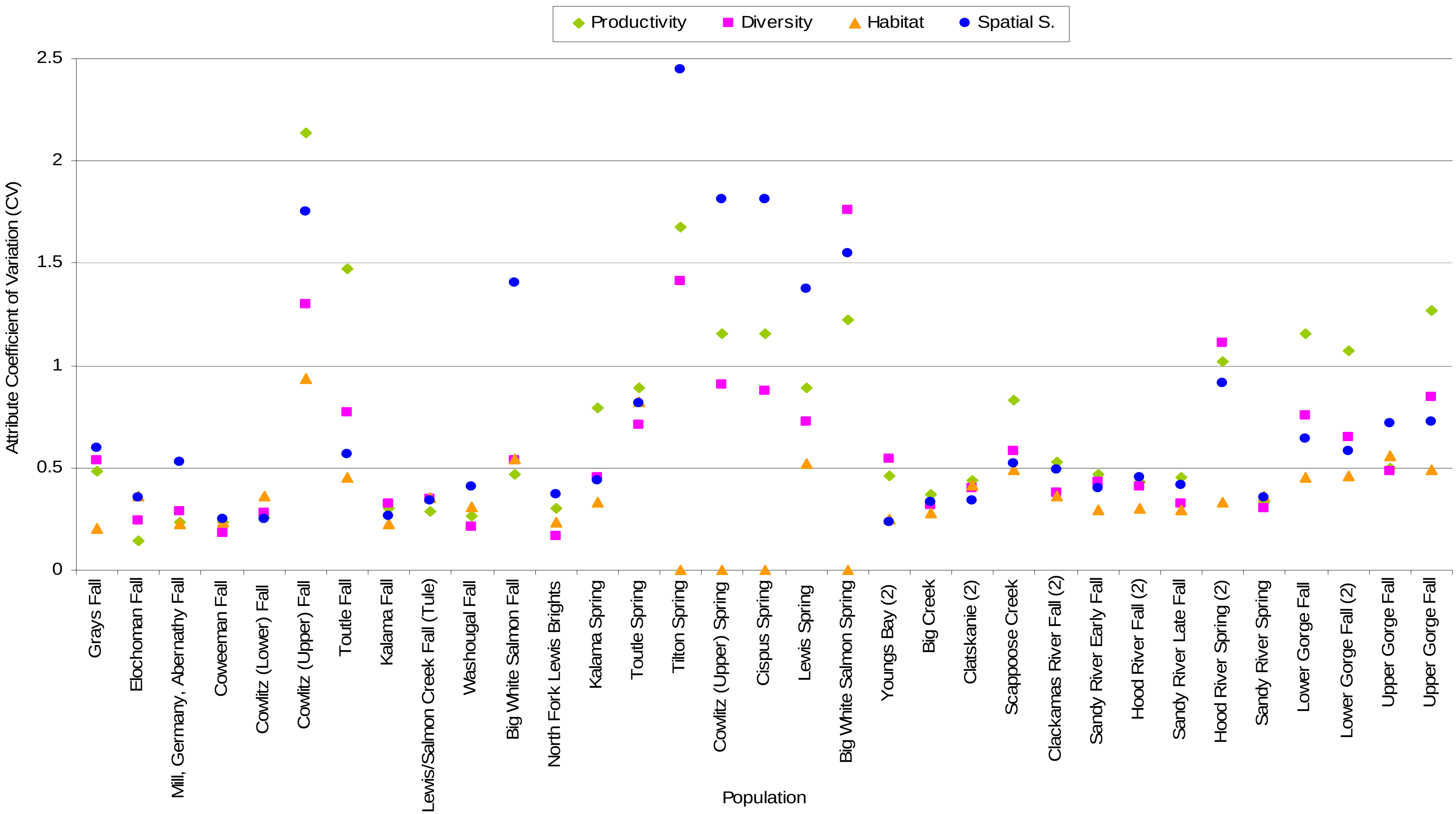


Figure 22. Coefficient of variation for average WLC-TRT member attribute scores for Lower Columbia River ESU Chinook salmon populations.

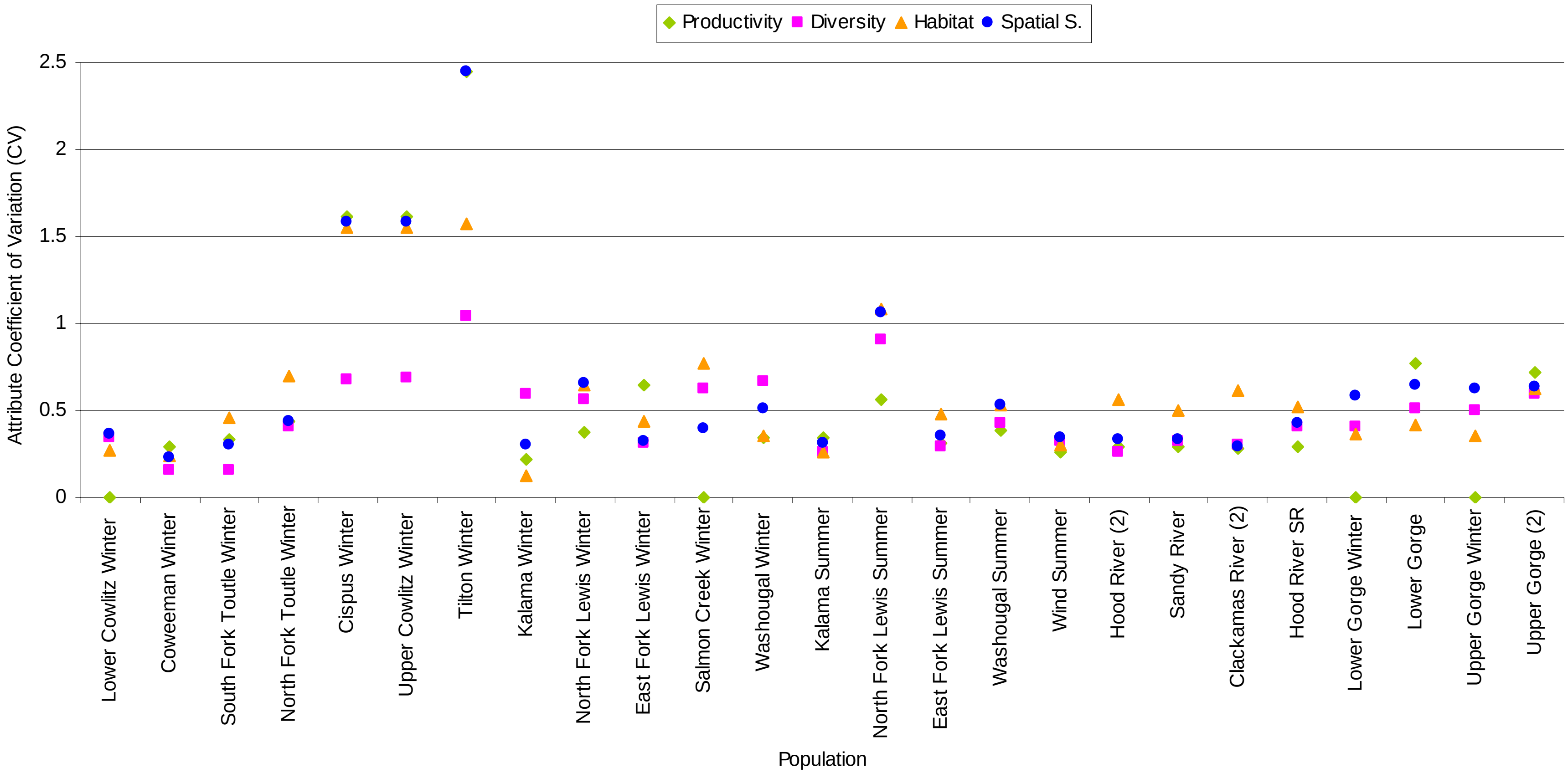


Figure 23. Coefficient of variation for average WLC-TRT member attribute scores for Lower Columbia River ESU steelhead populations.

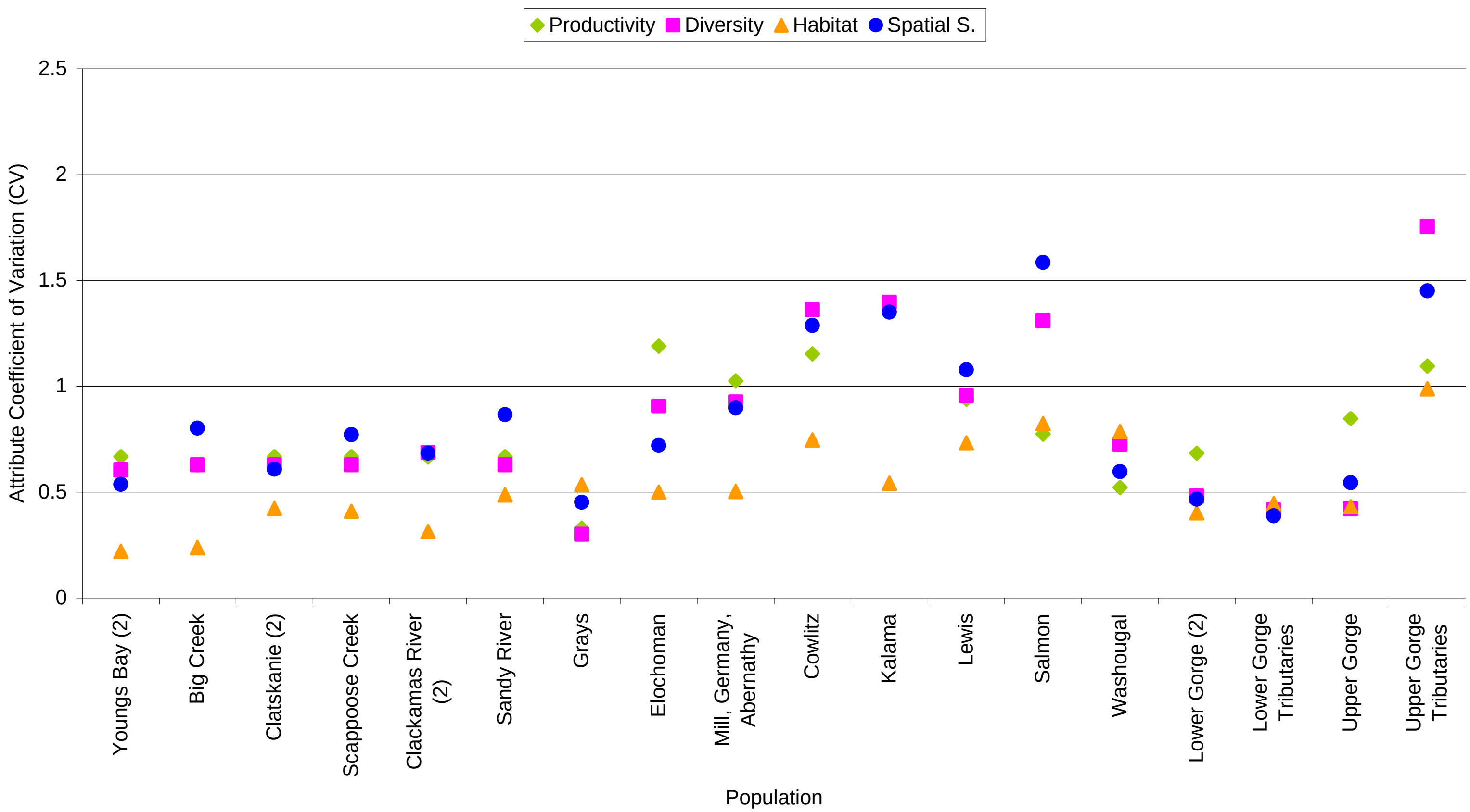


Figure 24. Coefficient of variation for average WLC-TRT member attribute scores for Columbia River chum salmon populations.

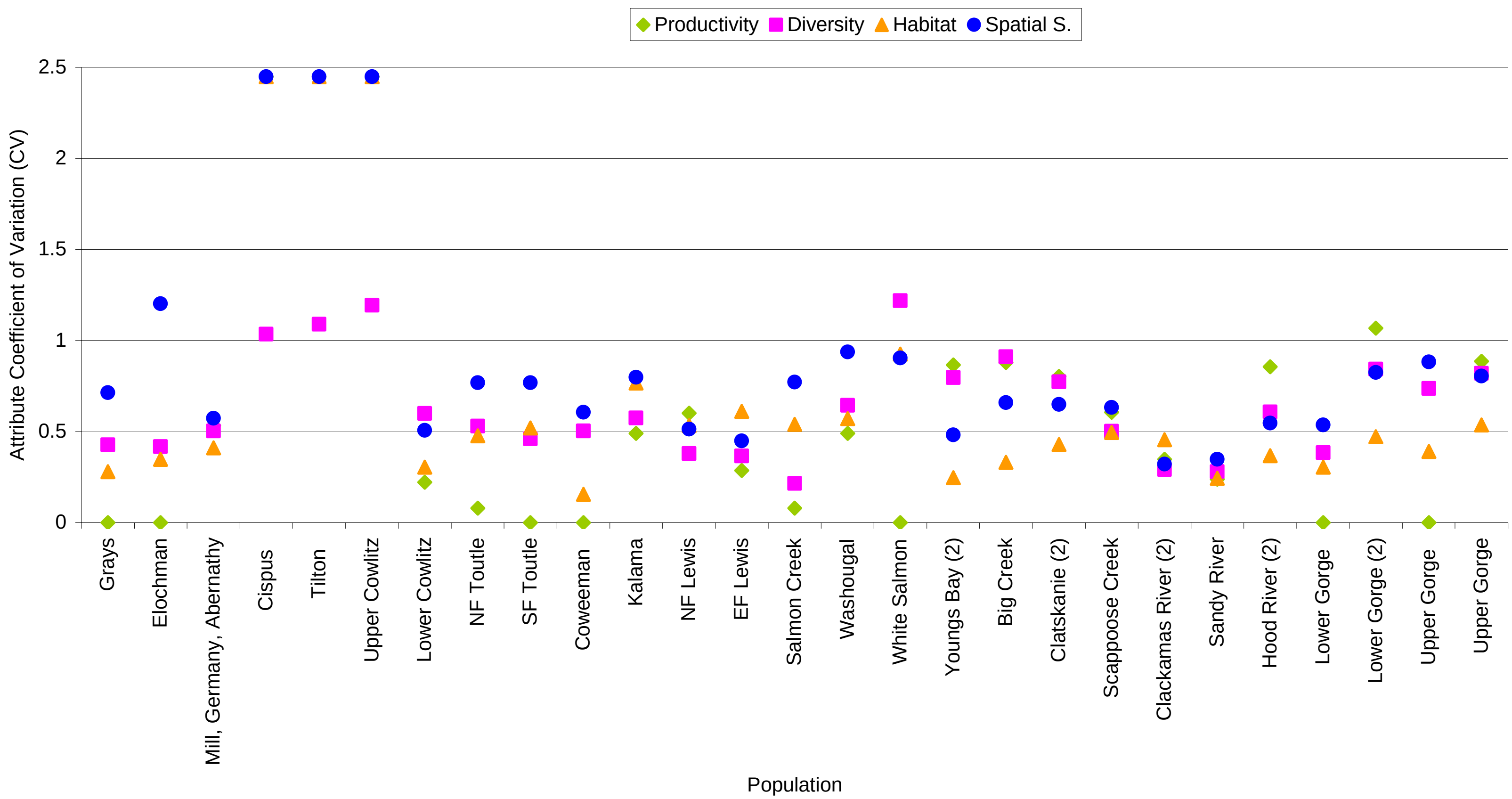


Figure 25. Coefficient of variation for average WLC-TRT member attribute scores for Lower Columbia River ESU coho salmon populations.

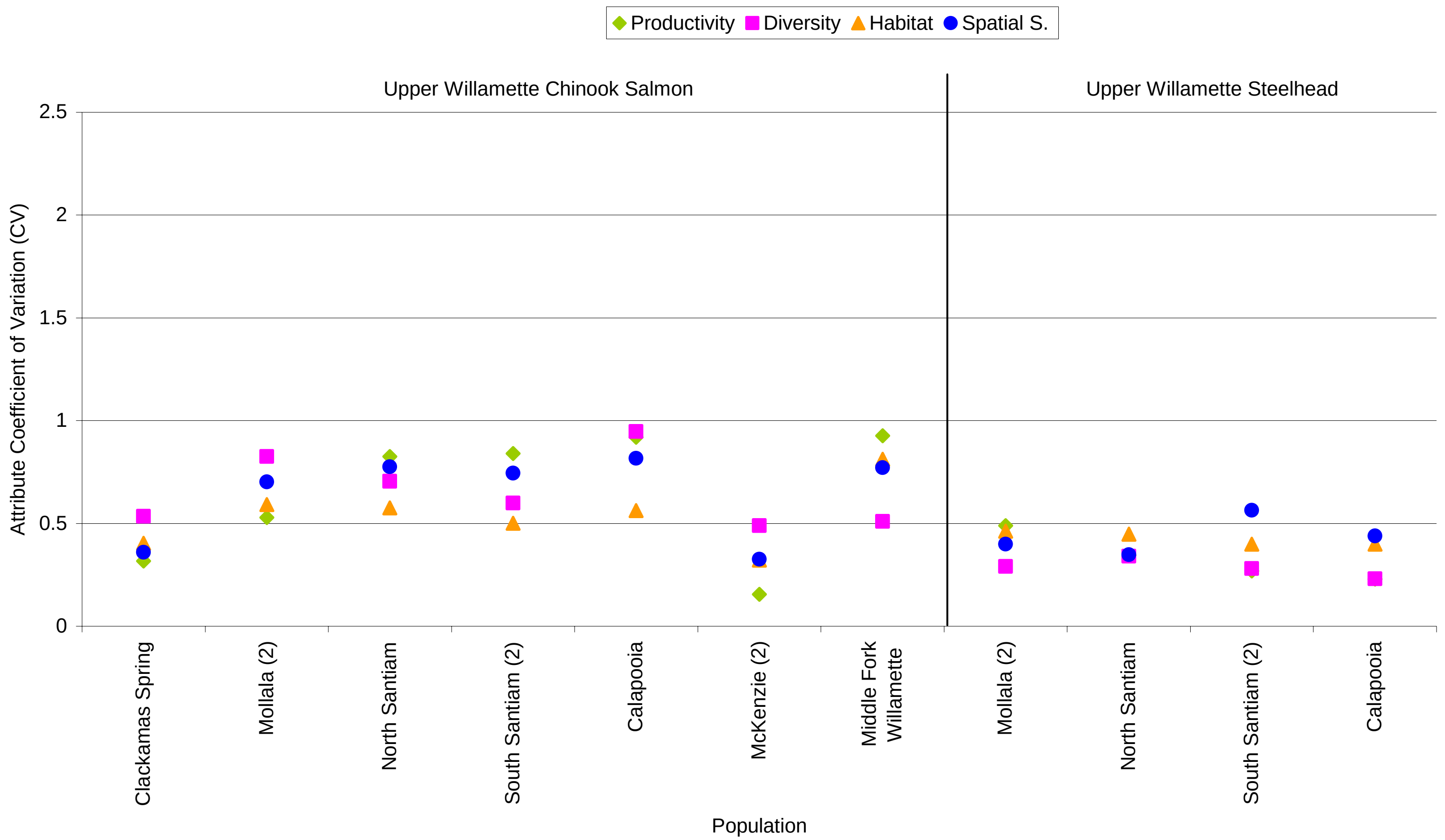


Figure 26. Coefficient of variation for average WLC-TRT member attribute scores for Upper Willamette River ESU Chinook salmon and steelhead populations.

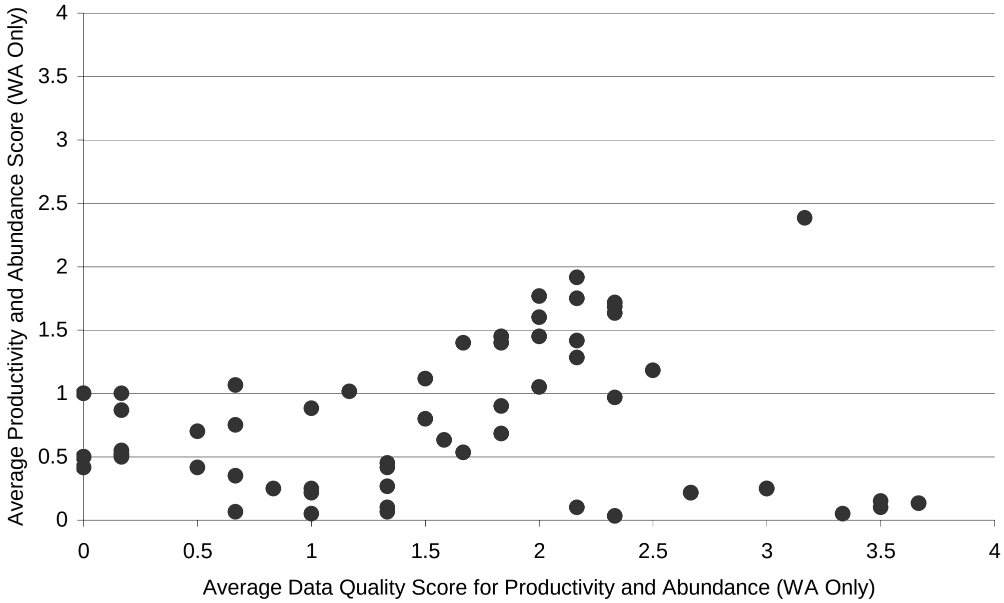


Figure 27. Relationship between the estimated abundance and productivity data quality and the average abundance and productivity score. All populations with a low data quality score had a low abundance and productivity score. Populations with higher data quality had a broader range of abundance and productivity scores. Data are for all Washington populations.

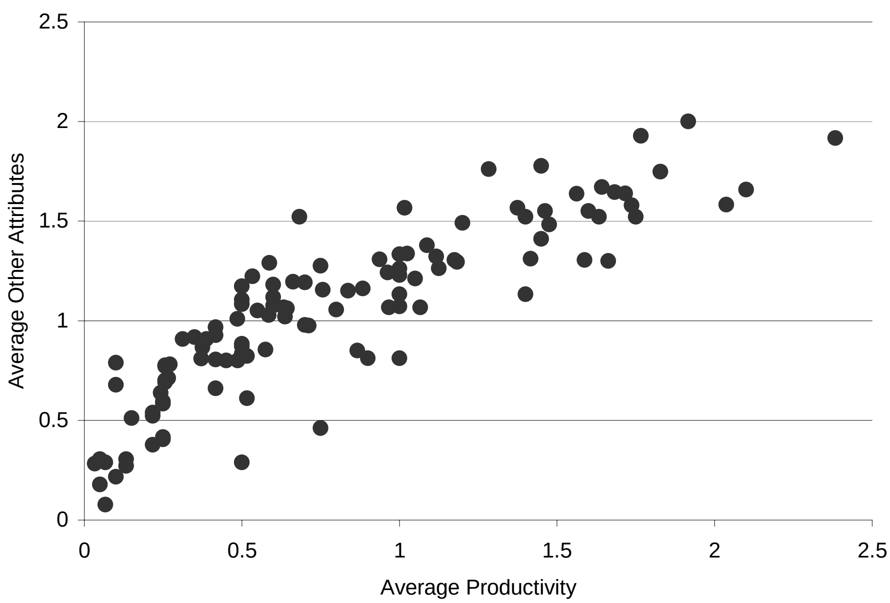


Figure 28. Relationship of average abundance and productivity score to the average of the other attributes (i.e., diversity, habitat, and spatial structure). Average is over all populations and ESUs.

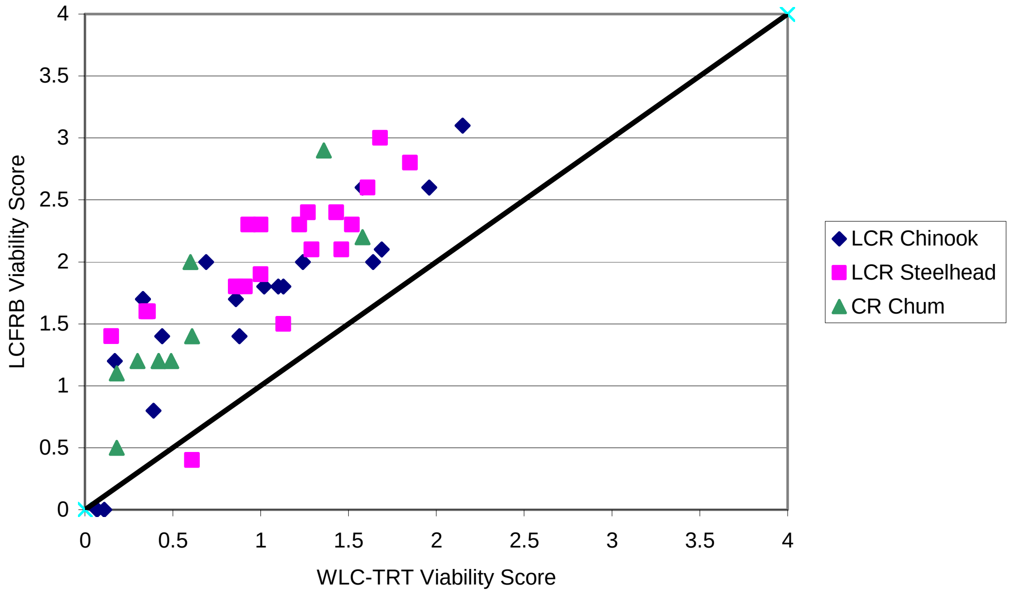


Figure 29. Comparison of WLC-TRT viability scores and LCFRB viability scores. The diagonal line shows the point at which the two scores would be equivalent. The LCFRB scores are consistently higher than the WLC-TRT scores.

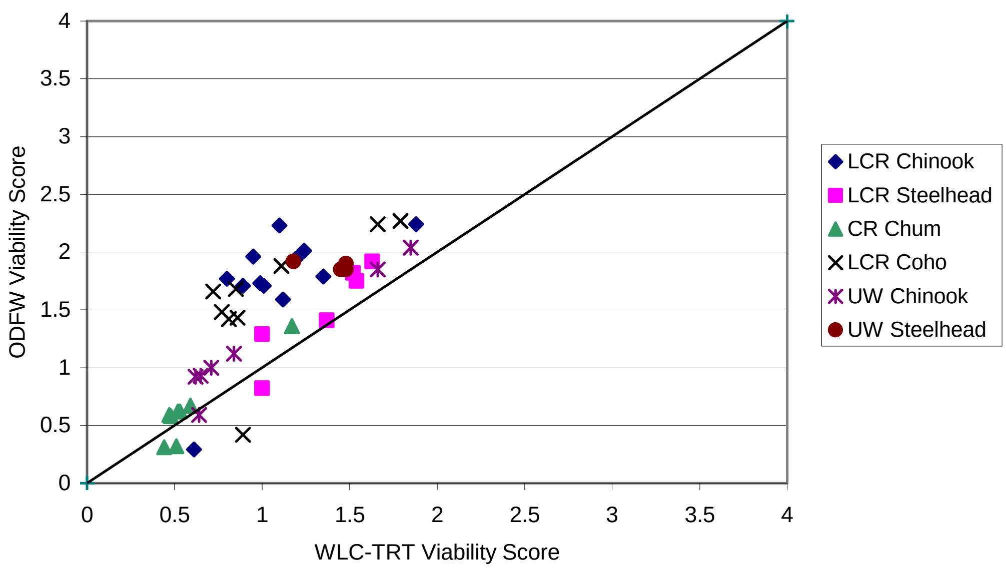


Figure 30. Comparison of WLC-TRT viability scores and ODFW viability scores. The diagonal line shows the point at which the two scores would be equivalent. The ODFW scores are consistently higher than the WLC-TRT scores at low to moderate persistence categories.

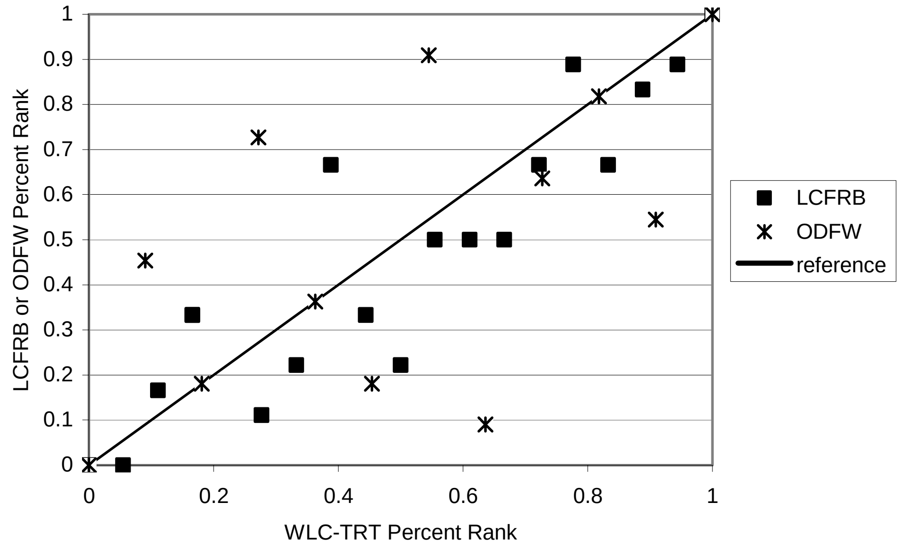


Figure 31. Comparison of percent rank for WLC-TRT, LCFRB, and ODFW viability scores for Lower Columbia River ESU Chinook salmon. If the WLC-TRT, LCFRB, and ODFW scored populations in the same rank order, all points would be on the diagonal reference line.

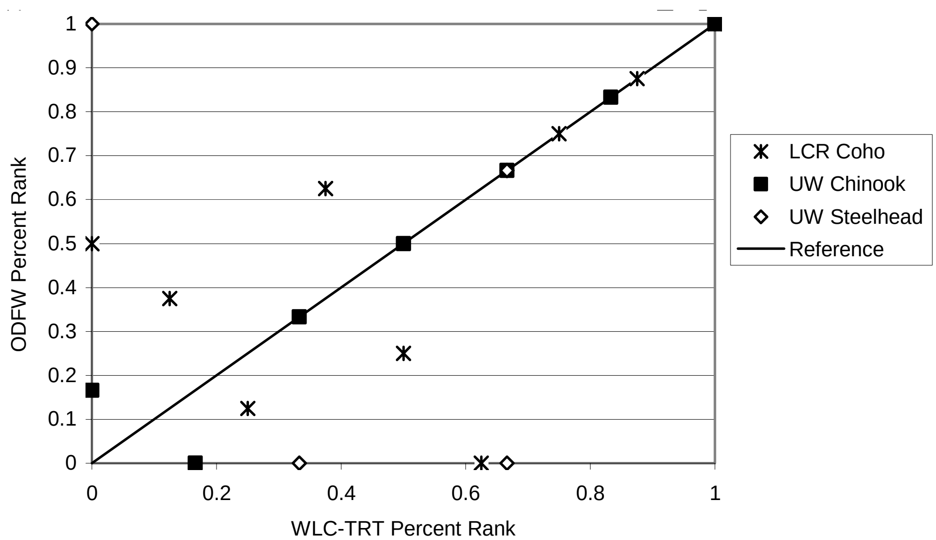


Figure 32. Comparison of percent rank for WLC-TRT, LCFRB, and ODFW viability scores for Lower Columbia River ESU steelhead. If the WLC-TRT, LCFRB, and ODFW scored populations in the same rank order, all points would be on the diagonal reference line.

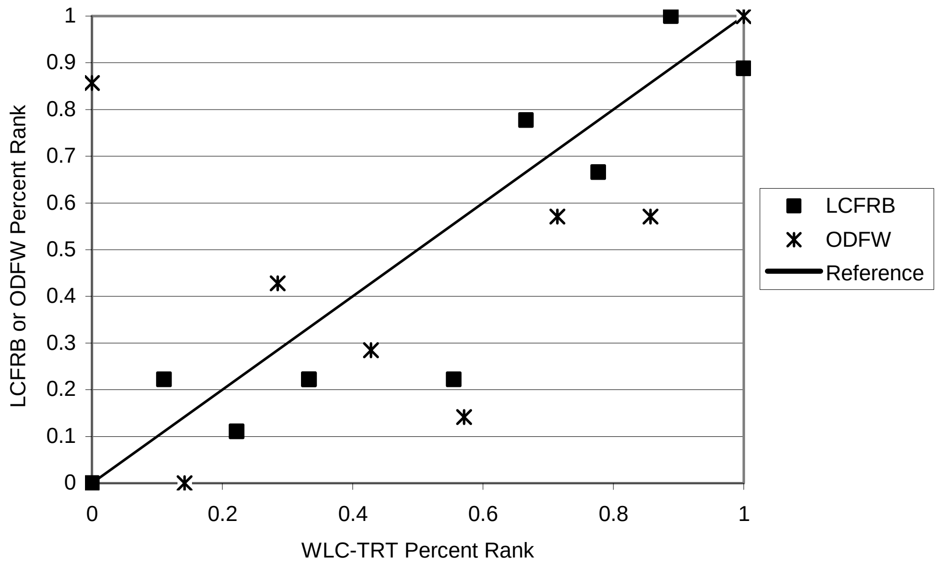


Figure 33. Comparison of percent rank for WLC-TRT, LCFRB, and ODFW viability scores for Columbia River chum salmon. If the WLC-TRT, LCFRB, and ODFW scored populations in the same rank order, all points would be on the diagonal reference line.

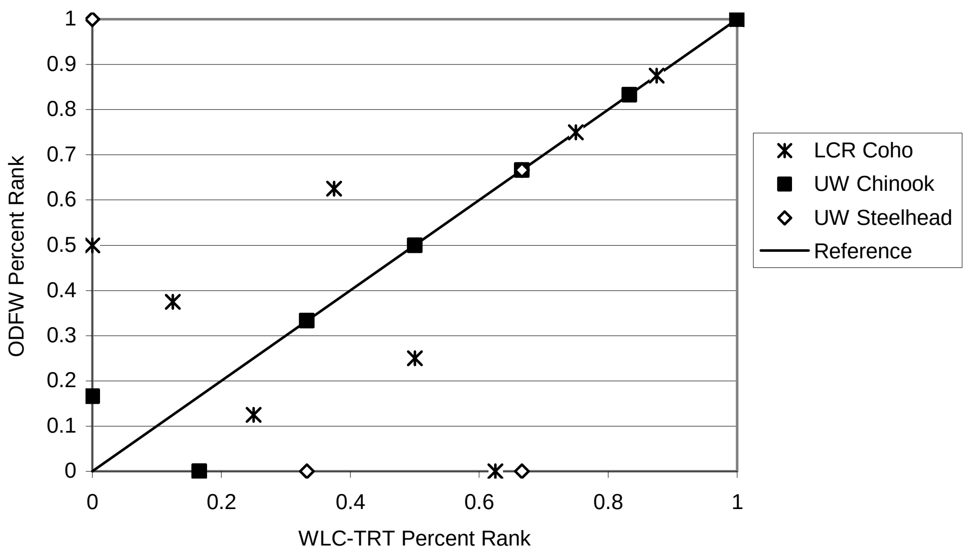


Figure 34. Comparison of percent rank for WLC-TRT and ODFW viability scores for Lower Columbia River ESU coho salmon and Upper Willamette River ESU Chinook salmon and steelhead. If the WLC-TRT and ODFW scored populations in the same rank order, all points would be on the diagonal reference line.

DISCUSSION

The current status evaluations have two purposes:

1. "Test drive" the approach to population evaluation used in the WLC-TRT viability criteria.
2. Provide input for recovery planning through a description of current population status.

This section discusses lessons learned about the viability criteria approach and provides information on interpreting and using the assessment of current population status for recovery planning. Integrated into the discussion of both these topics is consideration of the differences and similarities of the three different groups evaluating population status.

Evaluation of Viability Criteria

Viability criteria identify future conditions that, when met, would describe a viable population or ESU. Viability criteria need to identify the metrics and thresholds that will be used to determine whether a population is viable. In addition to metrics and thresholds, the WLC-TRT developed an overall process for evaluating the population extinction risk. This process integrates quantitative metrics, qualitative metrics, and expert opinions into an assessment of overall population status. Setting viability criteria and describing an evaluation process has an inherent risk of obsolescence. We are developing metrics today that are expected to be applied decades in the future. Science will likely progress in providing better metrics by the time actual delisting is contemplated. However, setting informed criteria now accomplishes several goals:

1. It describes our best current understanding of appropriate targets and methods,
2. It provides estimates of the magnitude of improvement needed for recovery, and
3. It describes the data that need to be collected to evaluate population status in the future.

In the subsections that follow, we discuss some of the viability criteria issues raised during the evaluation of current status of populations.

Level of Criteria Specificity

Questions were raised during the evaluation process regarding the appropriate level of specificity of the criteria. At one extreme, risk evaluation could rely entirely on specific quantitative thresholds of specific metrics (e.g., if abundance > X, then population is viable). At the other extreme, risk evaluation could be based entirely on expert opinion, with no standardized thresholds and metrics. The WCL-TRT approach seeks to balance these extremes.

Using specific quantitative metrics only has the advantage of repeatability and the appearance of objectivity, but it has some distinct disadvantages. All extinction risk metrics have some uncertainty, limitations, and simplifying assumptions. The simplifying assumptions are likely to be met to different degrees in different populations. In addition, data available to evaluate specific metrics varies among populations, making it difficult to identify a single metric that is best for all cases. For example, simple extinction risk models have been used to evaluate risk to salmon (e.g., Dennis et al. 1991, McClure et al. 2002), but there are many situations for which these models are inappropriate or need to be interpreted with great caution. A suite of models could be used, but a complete set of prespecified rules for appropriately applying and interpreting each model could get very complex, especially since there is often no scientific consensus on the best model for a particular situation. Rather than rely on either a single simple metric or an overly complex rule set for deciding how to interpret a suite of metrics, an expert panel evaluation of multiple metrics is likely to provide the best assessment of population status. Another example of the limits of single metrics is evaluation of spatial structure where no single metric (e.g., percentage of habitat lost) would be a good predictor of extinction risk. The risk estimate would depend on the spatial map of the stream network and the spatial pattern of fish distribution. Since these conditions vary among populations in ways that are difficult to quantify and relate to risk, it is not clear that a "one-size-fits-all" metric would be appropriate.

Although an expert panel may provide a way to integrate multiple metrics into an overall population risk assessment, this too has some distinct disadvantages. The repeatability and objectivity of the evaluation are major concerns, as is the challenge of identifying specific *a priori* goals when the evaluation relies on an expert panel. The method used to evaluate risk should produce similar results when applied by different expert groups evaluating the same populations. If similar groups produce similar results, it suggests that the method is fairly precise, and increases confidence that it may also be accurate. (A better evaluation of accuracy would be comparison to completely different, but credible, assessment approaches.) Repeatability can be improved by carefully selecting expert panel members and considering standardized metrics. Thus, the TRT advocates the use of consistent metrics and identification of reference thresholds for evaluating extinction risk, but relies on an expert panel to integrate and interpret the metrics case by case. This seems an appropriate balance in the use of quantitative metrics and expert panels. Some issues raised in this section are discussed further below, including composition of expert panels, refinement of metrics and thresholds, and identifying goals for recovery planning.

Composition of Expert Panels

Several basic approaches are available for deciding on the composition of an expert panel to evaluate salmon population extinction risk. One approach is to rely on scientists with broad experience with extinction risk assessment but unfamiliar with the specifics of the populations being evaluated. The scientists would need to be provided with all the information necessary to conduct the evaluation. This approach has the advantage of using experts with broad expertise, lack of bias from previous work on the populations, and the requirement for clear documentation of all the population specific information used for the assessment. The approach has the disadvantage of potentially missing local expert knowledge that is not publicly documented and a potentially long evaluation time as the experts explore unfamiliar data. An alternative approach is to rely on a panel consisting only of local population experts. The advantages and disadvantages are the reverse of those for a non-local panel: a local panel can rely on undocumented information developed from experience, but perhaps (though not necessarily) having preconceived assumptions and lacking broader perspectives on population risk. Not surprisingly, the WLC-TRT recommends panels composed of both local and non-local experts, so that the panel can use the advantages of each. The panel should also contain generalists and specialists in disciplines relevant to salmon extinction risk assessment, with some members experienced in synthetic risk analyses and other members experienced in relevant specific disciplines like population modeling, habitat processes, genetics, etc. The panel also needs to be large enough that all the relevant disciplines are represented and that average scores are not driven by the opinion of only one or two individuals. The assessment will more accurately reflect the "best available science" if the results represent the overall perspective of a large, well-selected group than if they reflect the opinion of only a few individuals. The role of group composition in interpreting the current risk evaluation is discussed in a section below.

Uncertainty and Variability

The evaluation approach seemed to do a reasonable job of capturing the uncertainty in the assessment. There are multiple levels of uncertainty and variability in the evaluation process, including (1) data and analysis uncertainty, (2) individual review uncertainty, (3) among-individual variability, and (4) among-group variability. It is important to understand the causes and consequences of each level.

The first layer is uncertainty in the data and metrics that underlie the assessment. Wherever possible, confidence levels and other measures of uncertainty (quantitative or qualitative) in the data and metrics need to be presented. For example, in the data reports used for the current status evaluations, growth rates were presented with confidence limits and a description of the many assumptions used to calculate the statistics. Another example of capturing data uncertainty, the potential biases inherent in the "accessible KM" estimates, is described in the data reports. Obviously, it is important to thoroughly understand and document the limits and caveats associated with the data and analyses. The "data quality" score for each population attribute describes the expert assessment of the overall amount of information available to evaluate each attribute. In the current status evaluations we identified a relationship between abundance viability score and data quality, with higher viability scores only occurring with higher data quality scores (Figure 27). This relationship is correlational, thus it is difficult to determine whether higher data quality scores lead reviewers to give higher scores or whether monitoring bias results in higher quality data for lower risk populations (this is all relative; none of the populations had particularly high persistence scores).

Another level of uncertainty or variability is the confidence that individual biologists placed in assigning scores to individual population attributes. To capture this uncertainty, we relied on the distribution of ten "certainty points." As indicated in Figures 12–16, individual panel members were seldom completely confident about the risk associated with each attribute; in most cases they spread their ten points among multiple population categories. In some cases, biologists spread their points over four of the five categories, indicating great uncertainty.

A third level of uncertainty or variability exists in the differences among biologists as they integrate information contained in the data and metrics. These differences are caused by a host of factors, including different scientists emphasizing different metrics, different personal knowledge of factors affecting the populations, and different areas of expertise leading to different interpretations. Since the status evaluations are about predicting extinction risk, it is an effort to predict the long-term future (e.g., 100 years) using current information. This is a highly uncertain endeavor, and it is not surprising that different biologists make different predictions. However, the degree to which biologists converge on similar assessments is informative. In the WLC-TRT evaluation of current status, there is variation on the level of convergence, with Figures 7–26 all providing different information about variability among TRT members. Patterns in this variability are difficult to describe. On a gross scale, the scores are fairly convergent, with average individual scores tending to cluster within neighboring categories. For example, the panel did not tend to have extreme splits: some members concluded a population was at very high risk, while others concluded the same population was at a very low risk. In general, most individual average scores were in the very high to moderate risk range. However, some populations showed some markedly higher variation in scores (Figures 22–26). Many of these were populations in the lower Columbia River, with a large portion of available habitat above dams. The probable reason for high variability in these cases is discussed below in "Habitat above Dams and Reintroductions."

The fourth level of uncertainty or variability occurs because of differences among groups evaluating the populations. Ideally, to look at among-group variability, multiple panels would be convened whose members were selected from a large pool using a carefully designed stratified random sample protocol using the panel composition guidelines described above. This was certainly not the case for determining the composition of the three groups that evaluated the current status of WLC populations in 2003; therefore, our conclusions about group variability must be limited. The three groups (WLC-TRT, LCFRB, and ODFW) each tended to represent specific types of expertise: the WLC-TRT tending to have a broader range of expertise, the LCFRB having strong local knowledge and departing from the WLC-TRT methodology, and the ODFW being a small group with strong local knowledge following the WLC-TRT methodology. Thus the recent evaluation may say more about the consequences of group composition and variations in evaluation procedure than about group variability per se. Even given the difficulty of interpretation because of variation in group composition and procedure, the scores tended to be relatively close, suggesting that different groups might tend to give similar qualitative scores using this procedure. However, for some populations there were differences in the assessed population status among groups. Efforts to identify more standard metrics and thresholds (discussed in the section "Level of Criteria Specificity") should lead to more consistency among groups.

Understanding each level of uncertainty and variability is important for management decisions. First, understanding uncertainty in the assessments provides information on how the uncertainty could be reduced in future assessments. Could uncertainty be reduced by providing more accurate data? By increasing scientific consensus on existing metrics? By paying more attention to group composition? Even if the uncertainty cannot be reduced, knowing which conclusions have high confidence and which ones are highly uncertain should inform the level of "bet hedging" in management decisions. For example, based on all variability levels, conclusions regarding the current status of the Lewis River bright Chinook salmon population appear to be highly uncertain (i.e., Is the population currently "viable"?). The management decisions taken regarding actions affecting the Lewis River bright Chinook salmon need to be made in the context of that uncertainty. The management decisions made under uncertainty might be different than decisions made with 100% certainty that the population either was or was not currently viable.

Population Attributes

The key attributes evaluated (i.e., abundance and productivity, diversity, habitat, and spatial structure) encompassed all the key features needed to evaluate population extinction risk. Although additional criteria are required to ensure that extinction risk threats have been eliminated, the four key attributes were broad enough to include all biological risk metrics considered. Although there is overlap and correlation among the four attributes (Figure 28), it was possible to evaluate each attribute relatively independently. Data on all attributes were available for some populations, and all populations had a least some information on some of the attributes.

Few data were available to evaluate the JOM criteria described in the WLC-TRT's viability report (McElhany et al. 2003). Information on JOMs is most closely linked to abundance and productivity. In fact, the WLC-TRT suggests in the viability report that multi-stage models that include JOM data are a preferred way to assess abundance and productivity. Because JOM data are a subset of abundance and productivity data, the WLC-TRT suggests combining the non-declining JOM criteria as a component of the abundance and productivity criteria, rather than listing it as a separate attribute. This is a modification of the WLC-TRT's viability report (McElhany et al. 2003). One of the main reasons the WLC-TRT originally listed the JOM growth rate separately was to emphasize the valuable information on extinction risk available in a time series of JOM abundance and to encourage collection of these data. The WLC-TRT still very much believes that the assessment of JOM abundance and trend are critical indicators of population performance and that assessments will be greatly enhanced by collecting these data. Given that populations with low data quality always ranked low in terms of population status, increasing the quality of information alone could potentially improve the perception of a population's status (Figure 27). (Note: This is only a correlation; it is not possible to determine how data quality influences viability score.)

Habitat above Dams and Reintroductions

A number of issues were raised during the evaluation regarding populations whose historical habitat is largely or entirely inaccessible because of human-created barriers. This situation occurs for populations in the Cowlitz, Lewis, Big White Salmon, Sandy, North Santiam, South Santiam, McKenzie, and Middle-Fork Willamette Rivers. For these populations, the WLC-TRT (and LCFRB and ODFW) were confronted with how to evaluate both their habitat and the abundance and productivity associated with any recent reintroduction programs.

One approach to evaluate a population's habitat attribute is to consider only the quality of the habitat accessible to the population at the time of evaluation. Using this approach, the quality of habitat above large barriers would be ignored. The spatial structure parameter would reflect the increase in extinction risk caused by the loss of accessibility. Many TRT members believed this to be the best approach to capture a "snapshot" of extinction risk under current conditions. However, some TRT members felt that the quality of habitat above barriers should be considered in assessing a population's habitat attributes. The case for including this habitat was based on the view that the habitat attribute should consider all historical habitat and that loss of access to any part of that historical range should just be reflected in the spatial structure parameter. In this way, habitat quality problems could be separated from accessibility problems. The WLC-TRT did not reach a consensus on this question, and individual TRT members interpreted the criteria as they deemed appropriate. As a consequence, the habitat scores for these populations show a high level of variability among reviewers. A consensus on this question should probably be reached before populations are evaluated again.

For those members who only evaluated accessible habitat, a decision is required about whether to "count" areas where fish were recently reintroduced by trap-and-haul programs. If TRT members concluded that the reintroduction was "experimental," the area above the barrier was not considered in evaluating habitat. An experimental reintroduction was one where the population was clearly not self-sustaining and there was no clear commitment that the program would continue. For example, the reintroductions in the upper Cowlitz River were considered experimental because current JOM collection efficiency is so low that the populations are not self-sustaining and there was no commitment to continue the programs at the time of evaluation.

The treatment of reintroductions above inaccessible barriers was also an issue for evaluating abundance and productivity. In general, "experimental" reintroductions had little positive contribution to the abundance and productivity scores since the experimental reintroductions were, by definition, not yet self-sustaining. However, some TRT members considered the mitigating effect of the increase in wild spawning potentially created by the reintroduction (e.g., for Middle Fork Willamette Chinook salmon).

The different methods of considering habitat above barriers probably did not have a big effect on overall risk categorization, since the risk score also depends on three other attributes (abundance and productivity, spatial structure, and diversity). These other attributes tended to be low for populations with limited access to their historical range, so the populations tended to be ranked low regardless of habitat score. In conclusion, on this issue the WLC-TRT recommends adopting more consistency in how to consider habitat above inaccessible barriers and define "experimental reintroductions."

Current Population Status and Recovery Planning

Overall Assessment of Current Status

The number of populations in each persistence category is shown in Table 2. In the WLC-TRT evaluation, all populations were in the moderate, low, or very low persistence categories. Thus all populations were considered to be at an appreciable risk of extinction, and therefore each ESU and strata are at risk of extinction. The conclusion is consistent with the recent BRT review of ESU status, which found that all WLC ESUs are either "likely to become in danger of extinction" or are already "in danger of extinction." There is much useful detail in the individual population and attribute scores, but the overall message is that WLC ESUs are currently far from meeting the viability criteria defined by the WLC-TRT (McElhany et al. 2003).

Although the assessment is intended to describe absolute extinction risk, the WLC-TRT has more confidence in the assessment as a measure of relative status among populations than as a measure of absolute risk. Thus, there is more confidence in applications of the assessment that use relative risk measures than those that rely on an accurate assessment of absolute risk. This is not to say there is no confidence in the absolute risk assessment. In broad qualitative terms, there is strong support for the conclusion that most populations are at significant risk of extinction. However, we do not believe there is support for multiple decimal point accuracy in estimating extinction probabilities.

Differences among Scoring Groups

The first question regarding differences in WLC-TRT, LCFRB, and ODFW scores is whether they are meaningful. The TRT intended the evaluation system to be a qualitative assessment (i.e., are the populations at a high or a low risk?). If different groups characterize populations in a similar qualitative way, but with different numerical scores, then the evaluations do not substantively differ. Most population scores appear to be similar enough to be qualitatively

Table 2. Number and percentage of populations in each persistence probability category, by evolutionarily significant unit (ESU).

Persistence category*	Lower Columbia Chinook	Lower Columbia steelhead	Columbia River chum	Lower Columbia coho	Upper Willamette Chinook	Upper Willamette steelhead	All ESUs
Very high	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
High	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Moderate	6 (19%)	6 (24%)	1 (6%)	2 (8%)	2 (29%)	0 (0%)	17 (16%)
Low	18 (58%)	16 (64%)	6 (38%)	19 (76%)	5 (71%)	4 (100%)	68 (63%)
Very low	7 (23%)	3 (12%)	9 (56%)	4 (16%)	0 (0%)	0 (0%)	23 (21%)

* Persistence categories are based on overall scores from the WLC-TRT evaluation. Overall scores were categorized as 0–0.5 = very low, 0.5–.5 = low, 1.5–2.5 = moderate 2.5–3.5 = high, 3.5–4 = very high. Because of the nonlinearity of the scoring system, this categorization is only approximate.

indistinguishable. For some populations there do seem to be meaningful differences in the evaluations (e.g., Lewis River bright Chinook). For almost all populations, the WLC-TRT scores were lower than the LCFRB and ODFW scores (again, not all differences are meaningful).

Partitioning the viability scores into persistence categories can emphasize differences among the groups (Tables 2–4). The scoring system is essentially continuous, but portioning into risk categories requires the use of fixed thresholds (e.g., a low persistence category is a score of 0.5–1.5). If the TRT overall score was 1.4 and the LCFRB consensus score was 1.6, they would fall into different risk categories but would have qualitatively similar conclusions about the risk to the population. The TRT recommends using the actual scores to compare among groups (Figures 29 and 30) and to make subsequent calculations such as stratum averages. Both the actual scores and the persistence categories have value in communicating the results of the evaluation.

One reason it is difficult to evaluate precise differences among the numerical scores is because the scale is not linear. The range of persistence probabilities included in category 0 (i.e., 0%–40% in 100 years) is quite different from the range in category 4 (i.e., > 99% in 100 years). Because of this range variation, the 0.5 difference between a score of 1.0 and 1.5 does not

Table 3. Number and percentage of populations in each persistence probability category by evolutionarily significant unit (ESU).

Persistence category*	Lower Columbia Chinook	Lower Columbia steelhead	Columbia River chum	All ESUs
Very high	0 (0%)	0 (0%)	0 (0%)	0 (0%)
High	3 (16%)	3 (16%)	1 (10%)	7 (15%)
Moderate	10 (53%)	13 (68%)	2 (20%)	25 (52%)
Low	4 (21%)	2 (11%)	6 (60%)	12 (25%)
Very low	2 (11%)	1 (5%)	1 (10%)	4 (8%)

* Persistence categories are based on the consensus score from the LCFRB evaluation. Overall scores were categorized as 0–0.5 = very low, 0.5–1.5 = low, 1.5–2.5 = moderate 2.5–3.5 = high, 3.5–4 = very high. Because of the nonlinearity of the scoring system, this categorization is only approximate.

Table 4. Number and percentage of populations in each persistence probability category by evolutionarily significant unit (ESU).

Persistence category*	Lower Columbia Chinook	Lower Columbia steelhead	Columbia River chum	Lower Columbia coho	Upper Willamette Chinook	Upper Willamette steelhead	All ESUs
Very high	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
High	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Moderate	11 (92%)	3 (50%)	0 (0%)	5 (56%)	2 (29%)	4 (100%)	25 (54%)
Low	0 (0%)	3 (50%)	6 (75%)	3 (33%)	5 (71%)	0 (0%)	17 (37%)
Very low	1 (8%)	0 (0%)	2 (25%)	1 (11%)	0 (0%)	0 (0%)	4 (9%)

* Persistence categories are based on the consensus score from the LCFRB evaluation. Overall scores were categorized as 0–0.5 = very low, 0.5–1.5 = low, 1.5–2.5 = moderate 2.5–3.5 = high, 3.5–4 = very high. Because of the nonlinearity of the scoring system, this categorization is only approximate.

qualitatively mean the same thing as the 0.5 difference between a score of 2.5 and 3.0. This is another reason to be careful in interpreting the numerical scores. Considering the assessment qualitative rather than precise to the second decimal point allows for an appropriate comparison of the risks associated with different populations and attributes. This lack of linearity in the scoring system makes the evenly spaced threshold system for relating scores to categories used in Figures 1-7 and in Tables 2-4 only rough approximations.

The LCFRB, ODFW, and WLC-TRT scores could differ for a number of reasons. Possibilities include different data, different criteria for categorization, and different reviewers. The LCFRB and WLC-TRT did use different compilations of the information on fish and habitat. The LCFRB used information compiled as part of its technical foundation. The WLC-TRT relied on data reports the NWFSC compiled for the evaluation. For the Oregon evaluations, both the WLC-TRT and the ODFW biologists had access to the same population data reports compiled by the NWFSC. Although the data and analyses used for the WLC-TRT and LCFRB evaluations were not identical, they relied heavily on the same data sources (e.g., WDFW abundance time series), and we do not suspect that data differences are a big source of the differences in scores. Probably a more significant source of the difference is the criteria used to assign scores. The LCFRB scorers used a set of specific metric thresholds that they defined to assign scores, while the WLC-TRT relied more on an expert synthesis of multiple metrics. This issue is discussed in more detail elsewhere in this report. Finally, the scores likely differed because different biologists conducted the different reviews. Integrating all the available data into a risk assessment is a complex process, and different biologists will interpret the data differently and bring different backgrounds and areas of expertise to the process. Pulling together multiple areas of expertise is an advantage of the expert panel approach. The LCFRB, ODFW, and TRT processes could all probably have been improved by having an even broader range of expertise available (see “Composition of Expert Panels,” page 40).

It is interesting to speculate why the LCFRB and ODFW scores tended to be higher than the WLC-TRT scores. One possibility is a simple sampling artifact. None of the groups was particularly large (LCFRB and ODFW each had three biologists for some ESUs). It is possible that such small panels, if drawn from a large group of biologists, would always display substantial variability in levels of optimism about overall prospects for persistence. The different scores also may have resulted from different perceptions of the risk categories. The 0 category encompasses risks from already extirpated to a 60% chance of extinction in 100 years. It is not clear that any of the groups really applied the broad range in their evaluations. Although we can point to clear differences in group composition (e.g., extent of local knowledge or expertise), why any particular aspect of group composition would lead to a consistently higher or lower estimate of extinction risk is not apparent.

It is not possible to know which, if any, of the assessments are correct. The goal is to predict extinction risk in 100 years, so the assessments represent essentially untestable hypotheses in the short term. The WLC-TRT suggests that the assessments concur enough (i.e., that the populations are at risk of extinction) to tell, basically, the same story. In particular, the WLC-TRT, LCFRB, and ODFW tended to rank populations in the same relative order (Figures 31–34). Again, this suggests that the assessment is better as a relative measure of risk than as an absolute measure.

Using Viability Scores for Recovery Planning

The current status evaluation provides several pieces of information that should be useful for recovery planning, including

- the absolute and relative magnitude of improvement needed for recovery,
- identification of key attributes (i.e., abundance and productivity, diversity, habitat, and spatial structure) that need to be improved or maintained,
- a general framework for evaluating proposed recovery actions,
- recommendations for monitoring needed evaluate viability, and
- refinement of viability criteria and recovery goals.

It is also important to be clear about what the assessment does not provide: a detailed threats analysis that is sufficient to identify specific actions, and any information on the economic and social difficulty of achieving recovery.

Absolute and Relative Improvement

The assessment applies a consistent approach to evaluating the viability of WLC salmon and steelhead populations. The use of a consistent protocol is essential if current viability is to be compared across populations. No systematic evaluation of the viability of all the populations in the any WLC ESU had been previously conducted. Although the current assessment could be improved, it does provide the first opportunity for a comprehensive, consistent comparison of populations on both sides of the Columbia River. As noted above, the assessment is probably better at estimating the relative status among populations than at estimating the absolute status. Knowledge of the relative viability of each population should be useful in developing preliminary ESU-wide scenarios. The LCFRB is currently using the assessments to develop scenarios for the Washington portion of Lower Columbia River ESUs. Although, as noted above, the current status assessment does not describe exactly how difficult it will be to recover a population, there is likely to be some correlation between current status and cost of recovery. Populations currently closer to a viable status will generally be “easier” to recover than populations that are far from viable. The assumption of a correlation is probably sufficient for initial planning and prioritization. However, it is important that the assumption be tested on a population by population basis early in the recovery planning process.

Identification of Key Attributes for Recovery or Preservation

Although not a limiting factors analysis, the evaluation does suggest what the key attributes are for recovery (attributes below viability) or preservation (attributes at or near viability). Discussions of each attribute for each population are in Appendix B. In addition, the population data reports provide more information on population features that lead to a particular viability score. These features can provide important indicators of how to improve a population to a viable status.

Framework for Evaluating Recovery Actions

The TRT believes strongly that the key population attributes (i.e., abundance and productivity, diversity, habitat, and spatial structure) should all be considered in evaluating the potential consequence of proposed actions. That is, a proposed action should be evaluated in terms of its likelihood to improve a population's abundance and productivity, diversity, habitat, and spatial structure. The evaluations will necessarily describe the likelihood of improvement, since uncertainty prevents making predictions with absolute knowledge.

Although evaluation of all key attributes is essential, the TRT does not recommend using the numeric scoring system and weighted average of population attributes to describe an expected response to proposed actions. Use of the numeric scoring system would likely imply a greater sense of precision than is possible when predicting fish response to proposed actions. For example, stating that a proposed suite of actions would move a population's spatial structure from a 2.7 to a 3.1 implies a level of knowledge that simply does not exist. We suggest instead that predicted changes be described in more qualitative terms. For example, a proposed suite of actions may be predicted to have a high likelihood of changing the spatial structure of a population from a moderate risk factor to a low risk factor.

The TRT struggled with the issue of implied precision in using the scoring system to evaluate the current status of populations and in setting viability criteria. The numeric system was developed to evaluate population status based on observations of fish and habitat performance. When applied as intended, the numeric system should retain information on uncertainty in the assessment that is useful for managers. Much of that uncertainty information would be removed in using the numeric system to evaluate proposed actions, and the potential for incorrect interpretation is high. We cannot really evaluate whether a proposed action moves the spatial structure to a 3.1 vs. a 3.2, but we can probably evaluate whether a proposed action is likely to move a population into a substantially different risk category.

Monitoring to Evaluate Viability

The evaluation of current status provides a good opportunity to examine the data available to estimate population viability. The exercise led to the identification of numerous information gaps and a practical look at how information may actually be used to estimate viability. The WLC-TRT is exploring the development of a separate document on monitoring for viability that will incorporate any lessons learned from the status evaluation. In the interim, the data quality scores, notes on individual populations (Appendix B) and population data reports all provide raw information on current data strengths and weaknesses, which suggests opportunities to improve monitoring.

Refinement of Viability Criteria and Recovery Goals

The previous section, "Evaluation of Viability Criteria," describes many of the recommended refinements to the viability criteria. The current population evaluation can also be helpful in deciding how to develop specific recovery goals and criteria for specific populations. The WLC-TRT viability criteria are relatively generic, and they require population specific refinement to develop concrete population specific goals. A look at the metrics used to evaluate current status provides some clues about how such population-specific criteria may be expressed. For example, one metric for evaluating spatial structure that we examined is the fraction of historically accessible habitat that is currently accessible. This metric may be one component of a population-specific spatial structure criterion. (Though useful as one component, it would probably not be sufficient for a complete metric or specific enough for population-specific spatial structure criterion.). In conducting the evaluation, we identified a number of metrics we did not include in our data reports that may be useful for assessing population status. These new metrics will be incorporated into the revised data reports being generated by the NWFSC ("Conclusions and Next Steps," page 50).

One challenge in applying the WLC-TRT viability criteria approach is setting recovery goals. Ultimately, the WLCT-TRT recommends that risk be assessed via an expert panel, not a tidy set of quantitative metrics. While it makes sense to use an expert evaluation of extinction risk, a goal of "until the experts are happy" is not very satisfying. Consequently, specific goals should be established that rely on metrics that the expert panel will consider, including specific abundance and productivity targets, target spatial structures, target life history expression, and so on. While these goals provide clear direction and expected viable states, the final assessment of viability should not rely on a single metric or simple set of metrics. As a practical matter, evaluations of extinction risk and decisions to delist should rely on an integration of *all* available information, not just a few, prespecified statistics. Therefore, it is important to set quantitative goals, but be realistic about how they will actually be used.

Conclusions and Next Steps

The current population status evaluation made progress on two goals: to refine viability criteria and to inform subbasin planning about current viability. There is certainly opportunity for improvement on both issues, but, overall, the population status assessment methodology seemed to perform reasonably well, and the WLC-TRT believes the conclusions regarding risk to be qualitatively correct (i.e., most populations are at significant risk of extinction).

Several additional products are in development as spin-offs from the population evaluation project. These include a report on monitoring for viability by the WLC-TRT and a revision of the population data reports and atlases by the NWFSC. The revised population data reports are expected to be published as NOAA technical memoranda. They will incorporate new metrics and maps that the WLC-TRT did not consider as part of the 2003 evaluation but were suggested by the evaluation process. The most significant next step from the current evaluation will be to incorporate the results from the project into the subbasin plans.

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APPENDIX A
PARTICIPANTS IN REVIEW OF POPULATION STATUS

WLC-TRT and ODFW participants in population status evaluations by ESU are shown in Tables A-1 and A-2, respectively. Biologists participating in the LCFRB review were Ray Beamsderfer (SP Cramer), Guy Norman (SP Cramer), and Dan Rawding (WDFW). Dan Rawding is also member of the WLC-TRT, but did not participate in the WLC-TRT evaluations.

Table A-1. Table indicating which WLC-TRT members participated in evaluating each evolutionarily significant unit (ESU).

		WLC-TRT member									
ESU	**Number of reviewers**	**Tom Backman**	**Craig Busack**	**Steve Kolmes**	**Paul McElhany**	**Jim Myers**	**Dan Rawding**	**Ashley Steel**	**Cleve Steward**	**Tim Whitesel**	**Chuck Willis**
Washington											
Lower Columbia River Chinook salmon	6	X	X		X	X		X	X		
Columbia River chum salmon	6	X	X		X	X		X	X		
Lower Columbia River steelhead	6	X	X		X	X		X	X		
Lower Columbia River coho salmon	6	X	X		X	X		X	X		
Oregon											
Lower Columbia River Chinook salmon	8		X		X	X	X	X	X	X	X
Columbia River chum salmon	7		X		X	X	X	X	X		X
Lower Columbia River coho salmon	7		X		X	X	X	X	X		X
Lower Columbia River steelhead	8	X	X		X	X	X	X	X		X
Upper Willamette Chinook salmon	8	X	X		X	X	X	X	X		X
Upper Willamette steelhead	8	X	X		X	X	X	X	X		X

Table A-2. Table indicating which ODFW members participated in evaluating Oregon populations in each evolutionarily significant unit (ESU).

		ODFW participant					
ESU	**Number of reviewers**	**Dick Caldwell**	**Suzanne Knapp**	**Kathryn Kostow**	**Steve Mamoyac**	**Tom Stahl**	**Jeff Ziller**
Lower Columbia River Chinook salmon	3	X		X		X	
Columbia River chum salmon	3	X		X		X	
Lower Columbia River coho salmon	3	X		X		X	
Lower Columbia River steelhead	5	X	X	X		X	
Upper Willamette Chinook salmon	5		X	X	X	X	X
Upper Willamette steelhead	5		X	X	X	X	X

APPENDIX B
INDIVIDUAL POPULATION ATTRIBUTE SCORES

The data used for the WLC-TRT population evaluation are in the Draft Population Status Data Report (NWFSC 2003a–j). These reports contain the trends, spatial distribution maps, land cover maps, and other information used by the WLC-TRT.

Lower Columbia River Chinook Salmon—
Coastal Fall-Run Stratum

Grays River Fall-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	3.83	5.50	0.67	0.00	0.00	0.68	1.83
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	2.33	4.83	2.67	0.17	0.00	1.07	1.33
Habitat	1.00	5.83	2.83	0.33	0.00	1.25	2.58
Spatial structure	1.33	1.50	2.83	2.00	2.33	2.25	2.67

Weighted average: 1.10

Abundance and productivity: As a whole, the TRT was concerned about the very low recent escapement of fish to the Grays River. This decline is especially remarkable given improvements in ocean conditions and the decline in harvest rates that occurred during the same period. Many noted that the decline corresponded to the Chinook salmon hatchery releases, suggesting that little natural production is occurring, despite high escapements of the past. Some members suggested that a portion of the existing return might also consist of hatchery-origin fish from other basins.

Diversity: There was relatively little diversity information for the TRT to review for this population. Many members noted the long history of hatchery introductions (from a variety of sources, albeit mainly from within the ESU) into the basin and the apparently poor reproductive success of the existing naturally spawning population.

Habitat: Most TRT members were satisfied with the quality of habitat data available. Habitat comments included the high degree of impairment for most riparian areas, and the loss of side-channel habitat (via diking and tidal gates) in the basin's lower reaches. Many members noted that projections of continued low human population density suggest that habitat degradation will not increase as rapidly in this basin as for some others in the lower Columbia River.

Spatial structure: This attribute was rated very high. No major barriers to fish passage were noted, although many TRT members suggested that smaller blockages (culverts, tidal gates, etc.) might have a significant influence on spatial structure.

Elochoman River Fall-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	1.33	6.83	1.83	0.00	0.00	1.05	2.00
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	1.00	5.67	3.33	0.00	0.00	1.23	1.83
Habitat	1.50	6.67	1.67	0.33	0.00	1.10	2.33
Spatial structure	1.17	5.17	3.17	0.50	0.00	1.30	1.83

Weighted average: 1.10

Abundance and productivity: The recent low abundance levels (especially in light of historical abundance estimates) in conjunction with high levels of hatchery-produced fish persuaded most TRT members to rate this population rather low. Others contrasted the strong negative trend in abundance with improvements in ocean productivity.

Diversity: Most TRT members' evaluations focused on the high proportion of hatchery fish returning to the basin. Others included information about the population's genetic distinctiveness.

Habitat: Impaired habitat throughout much of the basin, in addition to degraded river processes, influenced many TRT members in their evaluations.

Spatial structure: Several TRT members noted that access is somewhat impaired in the lower river reaches, which, in combination with low fish abundance, severely limits spatial structure.

Mill Creek Fall-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	2.33	5.67	2.00	0.00	0.00	0.97	2.33
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	2.50	6.00	1.50	0.00	0.00	0.90	1.67
Habitat	1.83	5.83	2.33	0.00	0.00	1.05	2.17
Spatial structure	2.17	3.83	3.33	0.67	0.00	1.25	1.83

Weighted average: 1.00

Abundance and productivity: Some TRT members contrasted this demographically independent population (DIP) with the Elochoman River fall-run Chinook salmon DIP. For both DIPs, abundances are low; however, some members identified the relatively lower fraction of hatchery fish in the escapement as an encouraging sign.

Diversity: Many members commented on the genetic similarity between Abernathy Creek fall-run Chinook salmon and fall-run Chinook salmon from Spring Creek National Fish Hatchery (NFH)(Upper Columbia Gorge DIP). Most members felt that this was the result of past hatchery transfers and that the current fish may not be as well suited to coastal tributaries.

Habitat: In contrast to other populations within the coastal stratum, the TRT members noted high human population density and the potential for further growth and habitat degradation. Most members noted that much of the habitat condition is relatively poor.

Spatial structure: TRT members identified marked differences between potentially usable habitat and habitat actually occupied by Chinook salmon.

Youngs Bay Fall-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	3.25	4.38	2.13	0.25	0.00	0.94	3.25
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	3.00	4.75	1.88	0.38	0.00	0.96	3.00
Habitat	1.00	5.13	3.38	0.50	0.00	1.34	1.00
Spatial structure	0.88	3.50	4.13	1.50	0.00	1.63	0.88

Weighted average: 1.12

Productivity and abundance: Most TRT members concluded that the extinction risk for this population is very high. Spawner surveys failed to find any returning adults in some years. Hatchery contribution to escapement in most years is probably very high.

JOM: Not rated.

Diversity: Hatchery fish make up a substantial portion of escapement. While many hatchery releases utilized within this ESU are tule fall-run hatchery stocks, the TRT was concerned about the use of Rogue River fall-run fish in Youngs Bay.

Habitat: Conditions are moderately degraded throughout much of the basin. The effects of timber harvest may be significant in the upper reaches, while residential and agricultural land use is a factor in the lower reaches.

Spatial structure: There was little information on fish distribution to use in the evaluation. Dikes and tide gates eliminate access to side-channel spawning and rearing habitat. Two major barriers were also mentioned as restricting access. Some TRT members considered that the numerous tributaries entering Youngs Bays provide the *potential* for good distribution.

Big Creek Fall-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	2.13	4.88	2.63	0.38	0.00	1.13	1.29
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	1.63	5.13	2.75	0.50	0.00	1.21	1.00
Habitat	1.38	5.38	2.88	0.38	0.00	1.23	1.25
Spatial structure	1.25	4.75	2.88	1.00	0.00	1.35	1.43

Weighted average: 1.19

Productivity and abundance: Adult escapement to Big Creek is relatively good, although redd counts indicate that there is little natural reproduction in the basin, and the majority of the fish return to the hatchery. The hatchery weir limits natural production to the less productive low reaches.

JOM: Not rated.

Diversity: Hatchery fish make up a substantial portion of escapement. Rogue River fall-run Chinook salmon were released from this site for a number of years, and it was unclear whether there had been any introgression between the tule and Rogue River populations. Genetically, this population resembles fish from the Spring Creek NFH, which suggests that the native population was effectively lost years ago. In the absence of any natural reproduction, the potential for local adaptation was considered minimal.

Habitat: Conditions are moderately degraded throughout much of the basin. The effects of timber harvest may be significant in the upper reaches, while residential and agricultural land use is a factor in the lower reaches. Riparian conditions were considered highly degraded.

Spatial structure: Most TRT members considered the hatchery weirs on Big and Gnat Creeks to be significant factors in limiting fish distribution.

Clatskanie River Fall-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	2.13	4.63	2.63	0.63	0.00	1.18	1.43
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	1.75	4.13	3.38	0.75	0.00	1.31	1.00
Habitat	2.38	4.75	2.50	0.38	0.00	1.09	1.38
Spatial structure	1.25	3.75	3.63	1.38	0.00	1.51	1.43

Weighted average: 1.24

Productivity and abundance: Escapement to this DIP has been consistently low, and the redd counts have been critically low, suggesting that few fish successfully reproduce. There have been few recent hatchery releases; however, some TRT members suggested that many fish were strays from nearby hatchery programs.

JOM: Not rated.

Diversity: There is little life history information available to evaluate these criteria. Age structure and run timing are consistent with tule fall-run Chinook salmon. Most TRT members were unsure of the effect hatchery strays have on locally spawning populations.

Habitat: TRT members were concerned that habitat quality in this DIP is not sufficient to sustain the population. Agriculture and residential development have degraded riparian and stream conditions.

Spatial structure: This DIP consists of numerous small tributaries that offer the potential for broad distribution; however, habitat conditions limit the utility of many stream reaches.

Scappoose Creek Fall-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	4.25	3.88	1.25	0.50	0.13	0.84	0.29
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	2.75	3.75	2.50	1.00	0.00	1.18	0.57
Habitat	2.75	4.88	2.13	0.25	0.00	0.99	1.38
Spatial structure	2.38	3.63	2.75	1.25	0.00	1.29	1.29

Weighted average: 0.99

Productivity and abundance: Aside from anecdotal reports of Chinook salmon, there is no information available for this population. Most TRT members utilized the “no data” default of 5, 5, 0, 0, 0.

JOM: Not rated.

Diversity: The only diversity information indicated very few hatchery fish have been released into this DIP.

Habitat: This DIP is generally moderately degraded. Residential development along the Columbia River, in combination with agricultural land use, has moderately to severely impaired many lower stream reaches.

Spatial structure: There was some uncertainty concerning the number of existing barriers in Scappoose and Milton Creeks. Poor habitat conditions were also suggested as a limitation to distribution.

Lower Columbia River Chinook Salmon—Cascade Fall-Run Stratum

Coweeman River Fall-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	0.33	2.00	6.00	1.50	0.17	1.92	2.17
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	0.17	1.00	4.50	3.83	0.50	2.35	2.17
Habitat	1.17	3.17	5.17	0.50	0.00	1.50	2.00
Spatial structure	0.33	1.33	5.17	2.83	0.33	2.15	1.83

Weighted average: 1.96

Abundance and productivity: This population is considered at a lower risk of extinction than other tule populations. It has a relatively low to moderate abundance, but with an increasing trend. The low incidence of hatchery fish is an additional positive indicator.

Diversity: Most TRT members highlighted the low level of historical and present-day hatchery contribution to escapement. Others identified the population's genetic distinctiveness as a further indicator of native diversity retention.

Habitat: The upper portion Coweeman River basin is forested, with relatively good or only slightly impaired habitat, whereas the lower basin is more heavily degraded. Furthermore, development in the Longview area has already impacted the river, with future human population growth (46%) likely to further degrade lower reaches.

Spatial structure: In general, fish accessibility was thought to be only slightly impaired, primarily in the lower basin.

Lower Cowlitz River Fall-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	1.67	4.83	3.50	0.00	0.00	1.18	2.50
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	0.67	4.33	4.67	0.33	0.00	1.47	2.17
Habitat	2.67	5.83	1.50	0.00	0.00	0.88	2.33
Spatial structure	0.33	4.50	4.67	0.50	0.00	1.53	2.17

Weighted average: 1.24

Abundance and productivity: This population has relatively low abundance (especially given historical productivity estimates), with a decreasing trend. The relatively high fraction of hatchery fish among the natural escapement was also considered in the risk evaluation. Preharvest estimates of recruits per spawner highlight the diminishing productivity of this population.

Diversity: TRT reviewers noted the high fraction of hatchery fish (67%) in the escapement, although any genetic effect is tempered by the fact that the hatchery broodstock was founded using native fish. Additionally, there was some concern regarding the inadvertent cross-breeding of fall-run and spring-run fish at the Cowlitz Salmon Hatchery.

Habitat: Conditions were generally considered poor throughout the basin. Agricultural and residential development and constriction of the river via bank armoring and diking were thought to be primary causes of impaired habitat.

Spatial structure: Loss of much of the historical spawning habitat and restricted access to side-channel spawning and rearing habitat may create patchiness.

Upper Cowlitz River Fall-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	8.50	1.50	0.00	0.00	0.00	0.15	3.50
Juvenile outmigrants	0.00	10.00	0.00	0.00	0.00	1.00	4.00
Diversity	6.83	3.17	0.00	0.00	0.00	0.32	3.00
Habitat	4.00	3.00	2.17	0.83	0.00	0.98	2.67
Spatial structure	7.67	2.33	0.00	0.00	0.00	0.23	3.17

Weighted average: 0.17

Abundance and productivity: Most TRT members considered this population extirpated from its natural habitat. Others argued that the current transport system above the dam will be maintained with future improvements in passage efficiency. (*Note: The TRT is developing guidelines to assist in evaluating populations sustained via trap and haul or similar barrier passage schemes*).

JOM: One TRT member assessed juvenile production based on collections of juveniles from the Cowlitz Falls facility.

Diversity: Some TRT members considered this population extirpated, while others suggested that some of its historical diversity was incorporated into the fall-run broodstock at the Cowlitz Salmon Hatchery.

Habitat: Some TRT members concluded that habitat above Mayfield Dam would not be considered because the current passage program was still "experimental." Mayfield Dam effectively isolated 100% of historical habitat from returning salmon. Other members considered that the passage program provided access to the habitat, and should therefore be evaluated.

Spatial structure: TRT members considered historical habitat inaccessible, however, some members were still inclined to acknowledge the passage program in their scores.

Toutle River Fall-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	5.33	1.83	1.17	0.00	0.00	0.42	0.50
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	4.67	4.17	0.83	0.33	0.00	0.68	1.00
Habitat	2.00	4.83	3.00	0.17	0.00	1.13	2.33
Spatial structure	2.67	4.33	2.50	0.50	0.00	1.08	1.33

Weighted average: 0.69

Productivity and abundance: There was considerable uncertainty in evaluating this population, due to the absence of any quantitative information on abundance. Anecdotal information indicated that fall-run Chinook salmon are present in the basin, but in unknown numbers. Some TRT members scored all their points in the 0 persistence category; others dispersed their points to indicate their uncertainty. (*Note: The use of default scores was adopted later in the meeting to accommodate this scenario. Under the default guidelines the productivity scores would have been slightly higher*.)

Diversity: Most TRT members were influenced by the widespread use of hatchery fish to reestablish/supplement the Toutle River population following the eruption of Mount St. Helens. It was acknowledged that the source of these hatchery fish was the Cowlitz River basin or other nearby systems, and that the existing population may have many of the pre-eruption population's life history traits.

Habitat: It was noted that much of the basin has moderately impaired hydrologic and riparian functions, but conditions have recovered considerably since the Mount St. Helens eruption.

Spatial structure: Most TRT members thought the Mount St. Helens eruption reduced this population's spatial structure, either through the creation of physical passage barriers or large patches of highly degraded habitat.

Kalama River Fall-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	0.50	3.33	5.00	1.17	0.00	1.68	2.33
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	0.50	3.83	4.50	1.00	0.17	1.65	2.50
Habitat	0.50	5.50	3.33	0.67	0.00	1.42	2.33
Spatial structure	0.33	2.33	5.17	2.17	0.00	1.92	2.17

Weighted average: 1.69

Productivity and abundance: TRT members presented varied interpretations of productivity information. Some members thought that the population was inherently weak, with a few strong return years and a generally downward trend. Other members thought the population was inherently stable. All members were concerned about the high hatchery component to escapement.

Diversity: All TRT members saw the high contribution of hatchery fish to escapement as a risk factor. Some members pointed out that the hatchery broodstock was largely derived from local sources. Others pointed to the apparent shift in run timing as an example of lost or modified diversity.

Habitat: The TRT noted moderately impaired conditions. Additionally, most fall-run habitat was in an area likely to experience further residential development.

Spatial structure: There was some discussion about increased range, with the laddering of Kalama Falls, although ultimately this increase did not tend to increase scores. Artificial range expansions in general did not lead to increased spatial structure scores. (The reference point was the historical distribution.) In general, aside from minor habitat blockages, the TRT thought that habitat access in the original range would be similar to historical access.

Lewis River/Salmon Creek Early Fall-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	0.33	4.17	4.67	0.83	0.00	1.60	2.00
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	0.50	2.33	4.00	2.67	0.50	2.03	1.67
Habitat	1.83	4.83	3.00	0.50	0.00	1.23	2.33
Spatial structure	1.17	4.67	3.33	0.83	0.00	1.38	1.83

Weighted average: 1.58

Productivity and abundance: Low average escapement and a slightly negative trend were common comments. TRT members also noted the relatively low contribution by hatchery-origin fish.

Diversity: TRT members noted the limited numbers of hatchery-origin fish introduced into the basin. There was some uncertainty regarding the origin of the existing fish, and some TRT members speculated that a limited number of hatchery strays could have established the existing population.

Habitat: This population includes three basins: North Fork Lewis River, East Fork Lewis River, and Salmon Creek. Each basin exhibits dramatically different habitat conditions. TRT members noted the urban development in the Salmon Creek basin and the lower Lewis River (North and East Forks) and the presence of major dams on the North Fork Lewis River.

Spatial structure: Of the three basins within the population boundaries, the Salmon Creek component is largely extirpated by habitat degradation, and some fall-run habitat was lost on the North Fork Lewis River with construction of Merwin Dam.

Washougal River Fall-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	0.50	3.17	4.83	1.33	0.17	1.75	2.17
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	0.33	3.33	4.50	1.83	0.00	1.78	2.50
Habitat	1.33	4.17	4.33	0.17	0.00	1.33	2.33
Spatial structure	1.17	3.83	4.33	0.67	0.00	1.45	2.17

Weighted average: 1.64

Productivity and abundance: A declining lambda and high hatchery fraction are the predominant concerns about this population, although some TRT members believed these risks are tempered by a recent average escapement of several thousand fish.

Diversity: The significant contribution of hatchery fish to escapement and the large number of different hatchery stocks that were incorporated into the Washougal Hatchery are risks to population diversity. Some TRT members, however, highlighted this population's genetic distinctiveness as evidence of the preservation of local genetic diversity.

Habitat: In general, the basin contains moderately impaired fall-run Chinook salmon habitat. Urbanization and residential development in the lower reaches contribute to habitat degradation, and TRT members believe that conditions will continue to decline in the near future.

Spatial structure: TRT members noted that most Washougal fall-run Chinook salmon in spawn in a 6-km reach of the river. Additionally, a number of barriers throughout the system limit fish distribution. There was some disagreement between Ecosystem, Diagnosis and Treatment model (EDT) dispersal measures and the NWFSC accessibility maps.

Clackamas River Fall-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	3.88	4.75	1.38	0.00	0.00	0.75	1.43
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	1.75	4.00	3.38	0.88	0.00	1.34	1.14
Habitat	2.38	5.00	2.38	0.25	0.00	1.05	1.38
Spatial structure	1.88	3.63	2.75	1.75	0.00	1.44	1.71

Weighted average: 1.01

Productivity and abundance: The long-term lambda for this population is less than 1. Adult escapement is low, but there is some uncertainty due to the poor quality of spawner surveys. Most TRT members noted that the hatchery contribution is low, and most escapement consists of naturally produced fish.

JOM: Not rated.

Diversity: This population was likely extirpated during the 1930s; however, it was reestablished with tule fall-run Chinook salmon (similar to the historical population) and has apparently been naturally self-sustaining for at least 15 generations.

Habitat: Urbanization and residential development greatly influence many lower reaches. Agriculture also is a factor of poor habitat condition. Conditions in the upper basin are considerably better, although this area is less utilized by fall-run Chinook salmon. There was also some uncertainty about whether water releases from North Fork Dam contribute to poor habitat conditions.

Spatial structure: Accessibility may be limited due to development (road crossings, culverts) in the lower basin.

Sandy River Fall-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	3.00	4.50	2.38	0.13	0.00	0.96	1.29
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	2.25	4.50	2.63	0.63	0.00	1.16	1.14
Habitat	1.88	4.88	3.38	0.38	0.00	1.28	1.38
Spatial structure	2.00	4.00	3.13	0.88	0.00	1.29	1.43

Weighted average: 1.10

Productivity and abundance: TRT members indicated that the majority of returns are of natural origin. Thus the apparent trend in abundance is positive.

JOM: Not rated.

Diversity: There have been a number of hatchery releases into the Sandy River. The last release was in the early 1980s. It was unclear whether the existing population is native or descended from early hatchery releases.

Habitat: Urbanization and agricultural land development produced impaired conditions in the lower reaches of the Sandy River. Upper stream reaches are in relatively better condition, but these areas are less utilized by fall-run Chinook salmon.

Spatial structure: Access to the Bull Run and Little Sandy River basins has been blocked for several decades. Habitat conditions in some lower tributaries may further limit access.

Lower Columbia River Chinook Salmon— Cascade Late Fall-Run Stratum

Lewis River Late Fall-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	0.33	1.33	3.00	4.83	0.50	2.38	3.17
Juvenile outmigrants	1.33	1.67	1.33	3.50	0.50	1.68	2.20
Diversity	0.17	0.83	4.83	4.17	0.00	2.30	2.67
Habitat	0.67	2.50	5.67	1.17	0.00	1.73	2.67
Spatial structure	0.17	4.33	3.67	1.83	0.00	1.72	2.67

Weighted average: 2.15

Productivity and abundance: TRT members generally categorized this population as being at a reasonable probability of persistence. Long-term high abundance levels (thousands of fish), combined with little hatchery contribution to escapement, are positive factors. Extensive available information helped many members to give scores with high levels of certainty, although this population showed some of the greatest levels of variability among reviewers. Harvest effects are a potential deterrent to recovery.

JOM: Juvenile information supports the conclusion that the population is sustainable.

Diversity: The relatively low influence of hatchery fish from outside programs and the large number of naturally produced fish on the spawning grounds suggest that this population retains much of it historical diversity.

Habitat: Merwin Dam eliminates access to approximately one-half of the historical spawning/rearing habitat utilized by the late fall-run Chinook salmon. Accessible habitat is in relatively good shape, but the lowermost reaches are degraded by urbanization, development, and dikes. Some members believe a potential risk factor is that habitat quality is partially maintained by regulated flows from Merwin Dam.

Spatial structure: Loss of access to areas above Merwin Dam and side-channel and floodplain habitat in the lower river are factors limiting spatial structure.

Sandy River Late-Fall-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	2.13	4.25	3.13	0.50	0.00	1.20	1.57
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	0.75	3.50	4.13	1.50	0.13	1.68	1.57
Habitat	1.00	4.88	3.50	0.63	0.00	1.38	1.43
Spatial structure	1.38	4.00	3.25	1.25	0.00	1.43	1.29

Weighted average: 1.35

Productivity and abundance: Natural escapement has been in the low hundreds of fish, but the TRT noted that the escapement is due to natural production. The long-term trend is negative, although the accuracy of abundance estimates was questioned.

JOM: Not rated.

Diversity: This population has a distinctive late fall-run life history strategy. Population size is small, but not critically so relative to effective population size. Hatchery influence is thought to be insignificant. There was some suggestion that a late (winter-run) portion of the run timing has been lost.

Habitat: Conditions in the lower portion of the Sandy River basin have been subject to moderate habitat degradation. Residential and agricultural development in the lower basin may be important factors influencing habitat quality. Some TRT members thought that relatively better habitat conditions in the upper watershed may benefit late fall-run fish spawning downstream.

Spatial structure: The loss of access to Bull Run and the Little Sandy River reduced much historical distribution. Habitat quality may also result in spawner patchiness.

Lower Columbia River Chinook Salmon—
Cascade Spring-Run Stratum

Upper Cowlitz River Spring-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	7.50	2.50	0.00	0.00	0.00	0.25	3.00
Juvenile outmigrants	8.50	1.50	0.00	0.00	0.00	0.15	2.50
Diversity	4.50	3.17	2.00	0.33	0.00	0.82	2.33
Habitat	10.00	0.00	0.00	0.00	0.00	0.00	2.17
Habitat (above dam)	1.33	4.00	4.33	0.33	0.00	1.37	2.33
Spatial structure	7.50	1.17	0.83	0.50	0.00	0.43	3.00

Weighted average: 0.33

Productivity and abundance: TRT members treated fish production related to the upper Cowlitz River trap-and-haul program differently. Some considered the program experimental (not contributing to sustainability), while others concluded that there was sufficient evidence of natural production to provide some possibility for persistence. In any event, the scores were not substantially different.

JOM: Some TRT members used information about juveniles collected at the Cowlitz Falls collection site in their JOM score. Other TRT members (those who considered the program experimental) did not score this attribute or awarded all their points to the 0 category.

Diversity: Many members considered this population extirpated, while others concluded that some genetic legacy still resides within the Cowlitz River Salmon Hatchery spring-run Chinook salmon broodstock.

Habitat: Mayfield and Mossyrock Dams prevent unassisted migration to the upper Cowlitz River basin. TRT members who considered the trap-and-haul program an established management program provided scores that evaluated habitat in the basin. Other members' evaluations included the upper Cowlitz River in order to provide information on the basin's potential productivity if access were restored.

Spatial structure: Mayfield and Mossyrock Dams prevent access to the upper Cowlitz River. Except for TRT members who considered the trap-and-haul program efficient enough to contribute to persistence, TRT member points were all in the 0 persistence category.

Cispus River Spring-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	7.50	2.50	0.00	0.00	0.00	0.25	3.00
Juvenile outmigrants	8.50	1.50	0.00	0.00	0.00	0.15	2.50
Diversity	4.50	3.33	2.00	0.17	0.00	0.78	2.33
Habitat	10.00	0.00	0.00	0.00	0.00	0.00	2.17
Habitat (above dam)	0.66	4.66	4.00	0.66	0.00	1.47	2.33
Spatial structure	7.50	1.17	0.83	0.50	0.00	0.43	3.17

Weighted average: .033

Productivity and abundance: TRT members treated fish production related to the upper Cowlitz River/Cispus trap-and-haul program differently. Some considered the program experimental (not contributing to sustainability), while others concluded that evidence of natural production was sufficient to provide some possibility for persistence. In any event, the scores did not differ substantially.

JOM: Some TRT members used information about juveniles collected at Cowlitz Falls in their JOM score; TRT members who considered the program experimental did not score this attribute or awarded all their points to the 0 category.

Diversity: Many TRT members considered this population extirpated, while others concluded that some genetic legacy resides within the Cowlitz River Salmon Hatchery spring-run Chinook salmon broodstock.

Habitat: Mayfield and Mossyrock Dams prevent unassisted migration to the upper Cowlitz River basin. TRT members who considered the trap-and-haul program an establish management program provided scores that evaluated habitat in the basin. Others provided evaluations that included the upper Cowlitz River in order to provide information on the potential productivity of the basin if access were restored.

Spatial structure: Mayfield and Mossyrock Dams prevent access to the upper Cowlitz River. Except for TRT members that considered the trap-and-haul program efficient enough to contribute to persistence, the remainder of TRT members placed all their points in the 0 persistence category.

Tilton River Spring-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	9.50	0.50	0.00	0.00	0.00	0.05	3.33
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	6.83	2.17	1.00	0.00	0.00	0.42	2.50
Habitat	10.00	0.00	0.00	0.00	0.00	0.00	2.33
Habitat (above dam)	2.67	5.00	2.00	0.33	0.00	1.00	2.33
Spatial structure	9.00	0.83	0.17	0.00	0.00	0.12	3.00

Weighted average: 0.11

Productivity and abundance: Most TRT members considered this population extirpated. Some members were unclear about the trap-and-haul program and placed 1 or 2 points in the 1 category rather than putting all points in the 0 category. The effect of this point hedging was very slight.

Diversity: Many TRT members considered this population extirpated, while others concluded that some genetic legacy still resides within the Cowlitz River Salmon Hatchery spring-run Chinook salmon broodstock.

Habitat: Mayfield Dam prevents unassisted access to the Tilton River basin. There is currently no program in place to restore Chinook salmon to the basin, although a few introductions have been attempted over the years. Some TRT members provided scores that evaluated habitat in the basin in order to provide information on the potential productivity of the basin if access were restored.

Spatial structure: The presence of an impassable dam prevents access to any of the historical habitat; most TRT members awarded all of their persistence points to the 0 category. One TRT member was skeptical that the Tilton River should be considered a separate spring-run Chinook salmon population and evaluated access based on the larger upper Cowlitz River basin.

Toutle River Spring-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	9.00	1.00	0.00	0.00	0.00	0.10	1.33
Juvenile outmigrants	10.00	NR	NR	NR	NR	NR	4.00
Diversity	5.83	4.00	0.17	0.00	0.00	0.43	1.83
Habitat	4.17	4.17	1.33	0.33	0.00	0.78	2.00
Spatial structure	4.17	3.83	1.67	0.33	0.00	0.82	1.67

Weighted average: 0.39

Productivity and abundance: In general, the TRT assumed that there were few if any spring-run Chinook salmon left in the Toutle River.

Diversity: In light of the negligible abundance, TRT members concluded that any fish present were probably introduced or stray Cowlitz Hatchery spring-run Chinook salmon. Some TRT members acknowledged that although these fish were not native to the basin, they likely expressed life history characteristics that were similar to fish that historically existed in the Toutle River.

Habitat: Much of the Toutle River basin is moderately impaired, primarily the residual effects of the eruption of Mount St. Helens. Most members were encouraged at the rate of recovery in many portions of the basins, although the headwater areas that spring-run Chinook salmon would frequent will probably be the last reaches to recover. Lower reaches of the river were influenced by urban and residential development, and conditions were expected to degrade further in foreseeable future.

Spatial structure: Some areas of the basin were made inaccessible follow the Mount St. Helens eruption. The presence of additional small barriers in the lower river probably also limit distribution.

Kalama River Spring-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	5.33	4.00	0.67	0.00	0.00	0.53	1.67
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	3.33	5.50	1.17	0.00	0.00	0.78	1.67
Habitat	0.83	5.50	3.33	0.33	0.00	1.32	2.17
Spatial structure	0.67	4.50	3.33	1.50	0.00	1.57	2.00

Weighted average: 0.88

Productivity and abundance: TRT members discussed the low absolute abundances recorded for this population and the general downward trend. The high percentage of hatchery fish included in escapement also figured prominently in the comments.

Diversity: The strong influence of hatchery introductions (primarily from the Cowlitz Hatchery), the continued predominance of hatchery fish on the spawning grounds, and the relatively poor performance of naturally spawning fish contributed to a relatively low diversity score.

Habitat: Conditions were moderately impaired throughout much of the basin, although headwater areas (spawning areas) are relatively better than the lower reaches, which have been degraded by residential developments. Furthermore, human population growth is predicted to continue, especially in the lower reaches of the river.

Spatial structure: Small barriers are likely present throughout the basin, although much of the larger tributaries and mainstem reaches were still accessible. Some TRT members were concerned about passage at the hatchery weir and at Kalama Falls.

Lewis River Spring-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	9.00	1.00	0.00	0.00	0.00	0.10	2.17
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	5.33	4.00	0.67	0.00	0.00	0.53	2.00
Habitat	1.67	2.83	3.67	1.83	0.00	1.57	2.33
Spatial structure	7.67	2.00	0.33	0.00	0.00	0.27	2.67

Weighted average: 0.44

Productivity and abundance: Currently the entire historical spawning habitat for spring-run Chinook salmon in the Lewis River is inaccessible behind three major dams (Merwin, Yale, and Swift). Abundance figures are given for spring-run fish spawning below Merwin Dam, but these were assumed to be strays from the hatchery program, which contribute little, if anything, to population sustainability.

Diversity: The native spring-run population may have been extirpated in the 1950s. TRT members considered the existing hatchery broodstock as the genetic reserve for any future introductions of spring-run fish above the Dams. The use of hatchery stocks from other spring-run populations in the Cascade stratum (primarily Cowlitz Hatchery) was thought to provide the Lewis River hatchery broodstock with suitable life history traits.

Habitat: TRT members noted that there was relatively good habitat above the mainstem dams, although logging and the effects of the Mount St. Helens eruption were concerns. Habitat below the dam is impaired by development, a situation thought likely to increase in the foreseeable future.

Spatial structure: Passage at the dams has not been attempted yet for Chinook salmon, although coho programs are under way. Most TRT members treated accessibility to historical spawning grounds as near 0, although some members were confident that an agreement for passage was likely in the near future.

Sandy River Spring-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	0.38	2.25	4.25	2.25	0.88	2.10	1.71
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	0.88	3.50	4.00	1.63	0.00	1.64	1.71
Habitat	0.88	3.63	3.75	1.75	0.00	1.64	1.38
Spatial structure	0.75	3.50	3.88	1.75	0.13	1.70	1.57

Weighted average: 1.88

Productivity and abundance: Dam counts at Marmot Dam provide a nearly complete estimate of escapement, although there is some spawning below the dam. The population trend is positive and absolute abundance is moderate. Hatchery influence was substantial in the past, but recently was reduced through selective removal of hatchery fish.

JOM: Not rated.

Diversity: There has been considerable influence from hatchery introductions from outside of the ESU, primarily the upper Willamette River. Genetic analysis indicates that considerable introgression has occurred between Sandy River and upper Willamette River fish. Future plans to completely remove upper Willamette River hatchery releases from the basin heartened some TRT members.

Habitat: Habitat in the upper basin, above Marmot Dam, is in relatively good condition. Conditions in the lower basin may negatively influence the survival and/or growth of outmigrating juveniles.

Spatial structure: Marmot Dam may present an impediment to returning adults, either through delayed passage or physical damage during the sorting of hatchery and wild fish. TRT memberes were also concerned that the blockage of Bull Run and the Little Sandy River eliminates access to historical spring-run habitat.

Lower Columbia River Chinook Salmon—Gorge Fall-Run Stratum

Lower Gorge Fall-Run Chinook Salmon (Washington)

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	7.17	2.17	0.67	0.00	0.00	0.35	0.67
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	4.67	4.33	1.00	0.00	0.00	0.63	1.17
Habitat	1.67	5.67	2.00	0.67	0.00	1.17	2.17
Spatial structure	2.83	5.00	2.00	0.17	0.00	0.95	2.17

Weighted average: 0.63

Productivity and abundance: There is little information available on this population. TRT members shared personal knowledge on the fall-run spawning aggregation below Bonneville Dam (Ives Island), and WDFW distribution maps were used as presence/absence indicators of population dispersal.

Diversity: Although there is some natural production in this population, many of the adults observed were thought to be hatchery-origin fish. Hatchery-origin, upriver, bright fall-run

Chinook salmon (Upper Columbia River Chinook Salmon ESU) that spawn below Bonneville Dam were considered a significant risk to diversity.

Habitat: Most accessible tributary areas are moderately or severely impaired. Numerous small tributaries are degraded due to urbanization.

Spatial structure: There were relatively few comments. Some TRT members thought that habitat degradation in many of the tributaries resulted discontinuous patches of usable habitat.

Lower Gorge Fall-Run Chinook Salmon (Oregon)

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	5.00	3.29	1.00	0.57	0.14	0.76	0.13
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	3.86	4.29	1.57	0.29	0.00	0.83	0.71
Habitat	1.50	3.25	3.88	1.00	0.13	1.45	1.29
Spatial structure	2.43	4.14	2.57	0.86	0.00	1.19	0.86

Weighted average: 0.96

Productivity and abundance: There is very little information available for evaluating these criteria. Anecdotal information suggests that abundance is very low.

JOM: Not rated.

Diversity: There have been relatively few hatchery releases into this DIP.

Habitat: This DIP is typified by numerous small tributaries with short accessible reaches. Conditions are moderately impaired along the lower accessible portions of most tributaries.

Spatial structure: Access to the larger tributaries in this DIP (Tanner and Eagle Creeks) is limited by hatchery weirs.

Upper Gorge Fall-Run Chinook Salmon (Washington)

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	4.83	4.00	1.17	0.00	0.00	0.63	1.58
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	4.00	4.50	1.33	0.17	0.00	0.77	1.83
Habitat	2.80	4.17	2.50	1.00	0.00	1.22	2.00
Spatial structure	2.50	4.00	2.50	0.83	0.17	1.22	2.17

Weighted average: 0.85

Productivity and abundance: There is little information available for this population, primarily spawner counts for the lower Wind River. Anecdotal information provided some additional escapement counts for the last few years for other minor tributaries.

Diversity: Large hatchery programs and limited natural production are factors that contributed to TRT concern for population diversity. Furthermore, the use of out-of-ESU upriver bright fall-run Chinook salmon increases the potential for habitat degradation.

Habitat: Loss of lower tributary reaches with the filling of the Bonneville Pool probably eliminated a considerable portion of the fall-run spawning habitat. Development along the Columbia River and logging in the uplands were also cited as causes for impaired habitat. No EDT data is available for this population.

Spatial structure: Loss of lower tributary reaches, mainstem spawning habitat, and degradation was thought to produce some patchiness in distribution.

Upper Gorge Fall-Run Chinook Salmon (Oregon)

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	5.14	3.29	0.86	0.57	0.14	0.73	0.14
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	4.43	4.00	1.57	0.29	0.00	0.80	0.57
Habitat	1.63	4.13	3.38	0.75	0.13	1.36	1.25
Spatial structure	2.86	4.14	2.14	1.00	0.00	1.14	1.00

Weighted average: 0.92

Productivity and abundance: Spawner surveys indicate the presence of adult Chinook salmon. The overall abundance of fish is very low and there is little information on the proportion of hatchery fish among the fish surveyed.

JOM: Not rated.

Diversity: Considerable numbers of fall-run fish (both tule and upriver bright Chinook salmon) have been released from the Bonneville Pool hatcheries. The low productivity of the small tributaries in this DIP makes it unlikely that naturally sustained populations persist.

Habitat: Much of the land in this DIP is under federal ownership. The lower reaches of most tributaries were inundated following the filling of Bonneville Pool. Habitat conditions along the Columbia River are moderately degraded, with better quality habitat in the upper reaches (although much of this habitat is inaccessible).

Spatial structure: Loss of habitat following the construction of Bonneville Dam reduced much of the distribution (including the loss of any mainstem spawning areas). The major tributary in this DIP (Herman Creek) is partially blocked by a hatchery weir.

Big White Salmon River Fall-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	3.17	4.67	2.17	0.00	0.00	0.90	1.83
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	2.00	3.33	3.83	0.83	0.00	1.35	2.00
Habitat	3.50	5.00	1.50	0.00	0.00	0.80	1.50
Spatial structure	7.17	2.83	0.00	0.00	0.00	0.28	3.00

Weighted average: 0.86

Productivity and abundance: Some TRT members commented that the population is extirpated from its historical range (except for 3 or 4 km below Condit Dam) and that the overwhelming majority of fish observed in the river are hatchery strays from one of the four major production hatcheries nearby. Other members considered the observed adults as *de facto* population members. Regardless, all TRT members noted the low total abundance this population exhibited, except for the most recent year or two.

Diversity: Most TRT members considered the in-river population of fall-run Chinook salmon to be heavily influenced by hatchery strays. Some TRT members included the Spring Creek NFH in their diversity evaluation as a potential source for reestablishing a native run. The Spring Creek NFH broodstock is thought to have been established using Big White Salmon River fall-run fish prior to the construction of Condit Dam.

Habitat: Most of this population’s historical habitat is inaccessible. Available habitat was further reduced with the filling of Bonneville Pool and development along the Columbia River.

Spatial structure: Condit Dam limits suitable habitat to a 3- or 4-km reach below the dam.

Hood River Fall-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	4.38	4.25	1.38	0.00	0.00	0.70	1.43
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	1.88	4.63	2.75	0.75	0.00	1.24	1.00
Habitat	2.38	5.13	2.38	0.13	0.00	1.03	1.25
Spatial structure	2.00	3.88	3.13	1.00	0.00	1.31	1.00

Weighted average: 0.95

Productivity and abundance: Dam counts suggest that escapement is very low. Additionally there is relatively little habitat below the dam, and it is unlikely that total escapement for the basin is substantially higher. Absent information on hatchery contributions to escapement, some TRT members were uncertain of natural spawner productivity.

JOM: Not rated.

Diversity: There is limited information available. In light of the low escapement TRT members were concerned about potential genetic bottlenecks and loss of genetic diversity.

Habitat: Much of the lower portion of the Hood River basin is severely degraded. Agricultural and residential development may factor into the relatively poor habitat condition.

Spatial structure: There was some concern about the potential for passage difficulty at Powerdale Dam. Additionally, water diversions and culverts may impede or restrict fish distribution throughout the basin.

Lower Columbia River Chinook Salmon—Gorge Spring-Run Stratum

Big White Salmon River Spring-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	9.33	0.67	0.00	0.00	0.00	0.07	1.33
Juvenile outmigrants	10.00	NR	NR	NR	NR	NR	4.00
Diversity	8.33	1.33	0.33	0.00	0.00	0.20	1.50
Habitat	10.00	0.00	0.00	0.00	0.00	0.00	1.50
Habitat (w/o dams)	3.75	3.50	2.75	0.00	0.00	0.90	1.50
Spatial structure	9.67	0.33	0.00	0.00	0.00	0.03	3.17

Weighted average: 0.07

Productivity and abundance: The TRT members considered this population extirpated from construction of Condit Dam. Some members included observed spring-run timed spawners at the base of Condit Dam, while others considered these fish as strays spawning in unsuitable habitat for spring-run fish.

Diversity: The TRT consensus was that extirpation of this population eliminated all its genetic resources.

Habitat: Although the entire historical spawning habitat for spring-run fish is inaccessible, some members chose to evaluate the habitat above the dam in order to highlight the potential benefits of removing Condit Dam (as was proposed for later in this decade). Agriculture is a factor in habitat impairment in mainstem areas.

Spatial structure: Almost the entire historical habitat in the Big White Salmon River basin is currently inaccessible.

Hood River Spring-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	7.38	2.13	0.50	0.00	0.00	0.31	2.14
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	7.38	2.00	0.63	0.00	0.00	0.33	2.33
Habitat	1.13	4.38	3.50	1.00	0.00	1.44	1.63
Spatial structure	4.38	2.75	1.88	0.88	0.13	0.96	1.57

Weighted average: 0.61

Productivity and abundance: The native population of spring-run Chinook salmon was extirpated. The existing population is the result of introductions from the Deschutes River (Middle Columbia River spring-run ESU).

JOM: Not rated.

Diversity: This population was reintroduced from outside the ESU; there is little evidence that it is sustainable.

Habitat: Much of the Hood River basin is severely to moderately degraded. Development in the lower reaches, combined with the impacts of glacial dam failures in the upper basin, reduced much of the system's capacity.

Spatial structure: Distribution may be impaired by poor quality habitat patches, irrigation diversions, and additional minor blockages. The laddering of Punchbowl Falls improved access to the West Fork Hood River.

Lower Columbia River Coho Salmon—Coastal Stratum

Grays River Coho Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	5.00	5.00	0.00	0.00	0.00	0.50	0.00
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	3.67	5.50	0.83	0.00	0.00	0.72	1.33
Habitat	1.50	5.17	3.33	0.00	0.00	1.18	2.17
Spatial structure	2.00	2.83	3.00	1.33	0.83	1.62	1.67

Weighted average: 0.84

Productivity and abundance: WDFW does not survey coho spawners; however, the presence of coho salmon has been noted throughout the basin. The TRT presumed that a large percentage of the observed adults were of hatchery origin and are not representative of natural production. The TRT agreed that for coho salmon in Washington tributaries, where no information is available, a default score would be 5, 5, 0, 0, 0 for persistence categories 0–4 respectively.

Diversity: The extensive release of nonnative coho into the basin, especially S-Type coho, was of concern to TRT members. Some members suggested, however, that spawn-timing differences and spawning site selection differences may minimize the potential for introgression between the two coho salmon run times.

Habitat: Impaired conditions are present throughout most of the basin, except for some headwater reaches (which may be inaccessible). Stream processes are also impaired. Although human population density is relatively low in the Grays River basin, forestry practices on private lands appears to have had a negative effect on habitat conditions.

Spatial structure: The TRT noted the loss of side-channel habitat in the lower basin. While no major barriers are present in the basin, poor habitat conditions may produce significant patchiness in fish distribution.

Elochoman River Coho Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	5.00	5.00	0.00	0.00	0.00	0.50	0.00
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	3.67	5.50	0.83	0.00	0.00	0.72	1.17
Habitat	2.50	6.50	1.00	0.00	0.00	0.85	2.17
Spatial structure	4.67	3.00	1.00	1.00	0.33	0.93	1.33

Weighted average: 0.67

Productivity and abundance: In the absence of spawner surveys or other assessments of abundance, TRT members utilized the default score (as discussed in the Grays River coho salmon section, page 72).

Diversity: TRT members were concerned about the intensity of hatchery releases from a variety of sources (including early-run, S-type coho salmon). Given the presumed low level of natural production, it would be difficult to maintain local adaptation under this level of artificial propagation.

Habitat: Poor stream and riparian conditions predominate throughout the basin. The lower reaches also exhibit reduced side channel connectivity and floodplain constriction.

Spatial structure: Total accessible habitat may be similar to historical, but poor habitat conditions probably restrict the range and result in occupied patches.

Mill Creek Coho Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	3.00	5.17	1.83	0.00	0.00	0.88	1.00
Juvenile outmigrants	0.50	2.00	0.83	0.00	0.00	0.37	0.50
Diversity	2.50	5.17	2.00	0.33	0.00	1.02	1.17
Habitat	1.67	5.67	2.17	0.50	0.00	1.15	2.17
Spatial structure	2.33	3.17	3.50	1.00	0.00	1.32	1.50

Weighted average: 1.02

Productivity and abundance: Some information is available to evaluate this population. A few hundred adults were observed returning to streams in this DIP. Most TRT members considered this level of escapement to be insufficient for a sustainable population. Other TRT members noted that escapement was a fraction of the estimated historical escapement

JOM: The amount of juvenile data available was limited. Nevertheless, the information demonstrated that natural production is occurring.

Diversity: As with other populations in this ESU, the magnitude of hatchery transfers into the basin was thought to have a negative influence on local adaptation and diversity. It was noted that with the recent termination of the hatchery programs, the potential for restoration of local adaptation increased.

Habitat: Much of the Mill Creek basin habitat appears moderately to highly impaired.

Spatial structure: There was considerable uncertainty about this population's evaluation. Some TRT members felt that much of the habitat is moderately to highly impaired, resulting in patchiness. Other members argued that this DIP's multiple (independent) streams add to population stability.

Youngs Bay Coho Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	5.14	3.86	0.86	0.14	0.00	0.60	1.29
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	4.86	3.86	1.00	0.29	0.00	0.67	1.14
Habitat	1.71	4.71	3.71	0.43	0.00	1.34	1.50
Spatial structure	1.86	3.86	3.29	1.00	0.00	1.34	1.14

Weighted average: 0.86

Productivity and abundance: TRT comments focused on the declining trend in abundance, the 91% hatchery contribution to escapement, and the very low overall abundance (especially during the 1990s).

JOM: Not rated.

Diversity: Large-scale hatchery releases and the relatively poor contribution of natural-origin recruits (NORs) to escapement are the major negative factors.

Habitat: Poor habitat conditions exist throughout Youngs Bay tributaries. Development and timber harvest are sources of degradation.

Spatial structure: No major blockages were identified (although there was some discussion about the hatchery weir on the Klaskanine as a potential impediment). Numerous small blockages (tide gates, culverts) may influence access to smaller tributaries and side channels. Patches of poor habitat could also affect the distribution of coho salmon.

Big Creek Coho Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	5.43	3.43	1.00	0.14	0.00	0.59	1.43
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	4.86	3.57	1.14	0.57	0.00	0.76	1.29
Habitat	1.14	5.29	3.14	0.43	0.00	1.29	1.43
Spatial structure	3.43	3.57	2.14	0.86	0.00	1.04	1.29

Weighted average: 0.81

Productivity and abundance: Abundance estimates suggest that total escapement is very small and the hatchery contribution is very large.

JOM: Not rated.

Diversity: Large numbers of fish have been released from Big Creek Hatchery; there is evidence that the Big Creek Hatchery broodstock is representative of the population. Hatchery fish make up a large fraction of total escapement, and there may be little opportunity to maintain a high degree of local adaptation.

Habitat: Moderately impaired conditions exist throughout the basin. Much of the degradation is the result of timber harvest in the upper basin and agricultural and residential development in the lower basin.

Spatial structure: The Big Creek Hatchery weir may prevent access to the upper Big Creek basin. Dikes and agricultural diversions impair access to side channels and small tributaries.

Clatskanie River Coho Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	5.00	3.71	1.14	0.14	0.00	0.64	1.43
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	4.71	3.86	1.00	0.43	0.00	0.71	1.29
Habitat	2.00	4.71	2.71	0.57	0.00	1.19	1.43
Spatial structure	2.71	3.29	2.43	1.57	0.00	1.29	1.00

Weighted average: 0.85

Productivity and abundance: Estimated escapement to this population is very low, and most returning fish are of hatchery origin.

JOM: Not rated.

Diversity: TRT members mentioned low effective spawning population size and large numbers of hatchery introductions from other populations as factors influencing the low persistence probability scores.

Habitat: Agriculture (especially in estuary areas), residential development, and timber harvest contribute to the degraded habitat condition.

Spatial structure: No major blockages were indicated in this DIP; however, dikes, water diversions, and tide gates all may limit access to small tributaries and side channels.

Scappoose River Coho Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	3.00	4.43	2.14	0.43	0.00	1.00	1.29
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	2.00	3.86	3.14	1.00	0.00	1.31	1.00
Habitat	2.43	4.57	2.57	0.43	0.00	1.10	1.43
Spatial structure	2.57	3.57	2.43	1.43	0.00	1.27	1.00

Weighted average: 1.11

Productivity and abundance: Recent improvements in escapement (up to the low 100s) follow a number of years of escapements of 0 or near 0. Reliance on a single peak index count in many years introduces considerable uncertainty into the evaluation. TRT members also noted that there have been few direct hatchery introductions into this area in recent years.

JOM: Not rated.

Diversity: Small population size could have created a genetic bottleneck or made the population susceptible to introgression by stray hatchery fish. Some TRT members focused on the absence of recent hatchery introductions.

Habitat: Conditions in this DIP are moderately to severely impaired. Agriculture and residential and urban development correlate strongly with severely impaired areas.

Spatial structure: Numerous small blockages (tide gates, culverts) may influence access to smaller tributaries and side channels. Patches of poor habitat could also affect coho salmon distribution.

Lower Columbia River Coho Salmon—Cascade Stratum

Coweeman River Coho Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	5.00	5.00	0.00	0.00	0.00	0.50	0.00
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	4.17	4.67	1.17	0.00	0.00	0.70	0.83
Habitat	1.50	4.00	4.33	0.17	0.00	1.32	2.17
Spatial structure	2.33	3.17	3.67	0.83	0.00	1.30	1.50

Weighted average: 0.80

Productivity and abundance: Most TRT members utilized the default 5, 5, 0, 0, 0 score for this population (see Grays River population, page 72). Other members utilized anecdotal information regarding coho salmon production in the basin, although overall deviation from the default value was slight.

Diversity: TRT members evaluating this population did not provide further notation for this criterion, other than extensive hatchery releases in the basin.

Habitat: TRT members noted that forestry practices in the upper basin have degraded conditions, whereas residential and agricultural development appeared to the primary cause of impaired stream habitat and function in the lower river reaches.

Spatial structure: Spatial structure was thought to be reasonably intact, relative to historical, with few barriers restricting access.

Lower Cowlitz River Coho Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	4.67	5.17	0.17	0.00	0.00	0.55	0.17
JOM	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	3.17	4.83	1.67	0.33	0.00	0.92	1.33
Habitat	2.33	6.17	1.50	0.00	0.00	0.92	2.17
Spatial structure	1.83	3.67	4.00	0.50	0.00	1.32	1.83

Weighted average: 0.80

Productivity and abundance: In the absence of any spawner surveys, most TRT members utilized the default values for coho salmon (see Grays River population, page 72).

Diversity: Intensive and extensive hatchery activity in the Cowlitz River likely profoundly influenced the existing population's genetic composition. Some TRT members noted that the source for most hatchery introductions is within the basin.

Habitat: Lower river conditions were found to be moderately or highly impaired. The current water release program from Mayfield Dam was also thought to have a negative effect on downstream river conditions (e.g., more high-flow events are needed to improve water quality and clean sediment from gravel beds). Agricultural and residential development were noted as having a negative effect on downstream conditions and processes. Furthermore, trends in human population growth likely further influenced this negative trend in habitat quality.

Spatial structure: While access to most larger tributaries was generally good, the loss of access to small tributaries and side-channel habitats and wetlands may constrict spawner dispersal in this basin.

Upper Cowlitz River Coho Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	9.00	0.67	0.33	0.00	0.00	0.13	3.67
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	6.17	3.00	0.83	0.00	0.00	0.47	2.50
Habitat (combined)	8.50	0.33	1.00	0.17	0.00	0.28	3.67
Spatial structure	9.33	0.67	0.00	0.00	0.00	0.07	3.50

Weighted average: 0.20

Productivity and abundance: Most TRT members considered this population extirpated from its historical habitat. A trap-and-haul passage program for coho salmon has transported fish above Mayfield and Mossyrock Dams for 5 years and collected juveniles at Cowlitz Falls and Mayfield Dam. Most TRT members considered this program experimental; it has a relatively poor juvenile collection efficiency, limiting its contribution to sustainability.

Diversity: Following construction of the mainstem dams on the Cowlitz River, most coho salmon migrating to the upper Cowlitz were collected at the Cowlitz Salmon Hatchery. A number of coho stocks from other basins have been brought into the Cowlitz Salmon Hatchery, creating the conditions to dilute native gene resources.

Habitat: TRT members who considered the passage program experimental did not evaluate habitat above the dams (which includes all of the upper Cowlitz River). Those that did evaluate it considered conditions above the dam, in general, only slightly impaired.

Spatial structure: Lack of a satisfactory passage program resulted in very low persistence category scores.

Cispus River Coho Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	9.00	0.67	0.33	0.00	0.00	0.13	3.67
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	5.83	3.17	1.00	0.00	0.00	0.52	1.67
Habitat	8.33	0.33	0.83	0.50	0.00	0.35	3.67
Habitat (w/passage)	0.00	2.00	5.00	3.00	0.00	2.10	2.00
Spatial structure	9.50	0.50	0.00	0.00	0.00	0.05	3.50

Weighted average: 0.22

Productivity and abundance: Most TRT members considered this population extirpated from its historical habitat. A trap-and-haul passage program for coho salmon presently transports fish above Mayfield and Mossyrock Dams and collects juveniles at Cowlitz Falls and Mayfield Dam, but most TRT members considered it experimental. The program's juvenile collection efficiency is relatively poor, which limits its contribution to sustainability.

Diversity: After dams were constructed on the mainstem Cowlitz River, most coho salmon migrating to the Cispus River were collected at Cowlitz Salmon Hatchery. A number of coho stocks from other basins were brought into Cowlitz Salmon Hatchery, creating conditions for dilution of the native gene resource.

Habitat: TRT members who considered the passage program experimental did not evaluate habitat above the dams, which includes all of the Cispus River. TRT members who did evaluate it in general considered conditions above the dam only slightly impaired.

Spatial structure: Lack of a satisfactory passage program resulted in very low persistence category scores.

Tilton River Coho Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	9.00	1.00	0.00	0.00	0.00	0.10	3.50
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	5.83	3.17	0.83	0.00	0.00	0.48	2.00
Habitat (combined)	9.17	0.67	0.17	0.00	0.00	0.10	3.67
Spatial structure	9.33	0.67	0.00	0.00	0.00	0.07	3.50

Weighted average: 0.16

Productivity and abundance: Most TRT members considered this population extirpated from its historical habitat. A trap-and-haul passage program for coho salmon transports fish above Mayfield Dam and collects juveniles at Mayfield Dam. Most TRT members considered the program experimental. Its relatively poor juvenile collection efficiency limits its contribution to sustainability.

Diversity: After dams were constructed on the mainstem Cowlitz River, most coho salmon migrating to the Tilton River were collected at Cowlitz Salmon Hatchery. A number of coho stocks from other basins have been brought to the hatchery, creating the conditions for a dilution of the native gene resource.

Habitat: TRT members who considered the passage program experimental did not evaluate habitat above the dams, which includes all of the Tilton River. TRT members who did evaluate it generally considered conditions in the Tilton moderately impaired, due in part to forestry practices.

Spatial structure: Lack of a satisfactory passage program resulted in very low persistence category scores.

North Fork Toutle River Coho Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	4.83	5.17	0.00	0.00	0.00	0.52	0.17
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	4.00	4.67	1.33	0.00	0.00	0.73	1.00
Habitat	3.33	4.67	2.00	0.00	0.00	0.87	2.00
Spatial structure	3.67	4.00	2.33	0.00	0.00	0.87	1.67

Weighted average: 0.67

Productivity and abundance: Most TRT members utilized the default 5, 5, 0, 0, 0 score for this population (see Grays River population, page 72). Other members utilized anecdotal information regarding coho salmon production in the basin, although overall deviation from the default value was slight.

Diversity: The Mount St. Helens eruption dramatically reduced the naturally spawning population of coho salmon. Although some natural production continues, much of the current escapement appears to be from the large numbers of hatchery fish introduced into the basin (out-of-basin sources). The hatchery broodstock may have served as a reservoir for genetic diversity in the years following the eruption.

Habitat: Much of the basin remains degraded 20 years after the eruption. Upper basin areas may continue to recover over the next few years, while conditions in lower river reaches are predicted to decline as human population density and development increase.

Spatial structure: Poor habitat conditions in many portions of the upper basin limit access and distribution. Some areas are still impassable as a result of the eruption.

South Fork Toutle River Coho Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	5.00	5.00	0.00	0.00	0.00	0.50	0.00
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	3.33	5.17	1.50	0.00	0.00	0.82	1.17
Habitat	2.17	4.33	2.83	0.67	0.00	1.20	2.00
Spatial structure	2.83	3.33	2.50	1.33	0.00	1.23	1.83

Weighted average: 0.79

Productivity and abundance: Most TRT members utilized the default 5, 5, 0, 0, 0 score for this population (see Grays River population, page 72). Other members utilized anecdotal information regarding coho production in the basin, although overall deviation from the default value was slight.

Diversity: Hatchery introductions have been fairly extensive; although the majority of releases have been from within the basin or nearby rivers. Additionally, most introductions from outside the basin have been S-type coho salmon, which are thought to be the historically dominant life history type in the basin.

Habitat: The Mount St. Helens eruption did not affect conditions in the South Fork Toutle to the same extent it did in the North Fork. Most TRT members considered the upper basin to be in fairly good condition, with more impaired areas in the lower reaches.

Spatial structure: Spatial structure was thought to be reasonably intact, relative to historical.

Kalama River Coho Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	5.00	5.00	0.00	0.00	0.00	0.50	0.00
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	3.17	5.67	1.17	0.00	0.00	0.80	1.17
Habitat	2.33	3.67	3.50	0.50	0.00	1.22	2.33
Spatial structure	2.00	4.00	2.67	1.33	0.00	1.33	1.50

Weighted average: 0.81

Productivity and abundance: Most TRT members utilized the default 5, 5, 0, 0, 0 score for this population (see Grays River population, page 72).

Diversity: There have been large-scale introductions of fish into the Kalama River, many from outside the basin. Apparently few wild fish are returning to the river, although the data are rather poor.

Habitat: TRT members considered the upper basin to be only slightly impaired relative to other populations. Development in the lower basin was a greater concern, with moderate levels of degradation and process impairment.

Spatial structure: Hatchery weirs may limit access in some cases, whereas the ladder at Kalama Falls may have expanded the range of coho salmon. This increased range did not tend to increase scores. Artificial range expansions in general did not lead to increased spatial structure scores. (The reference point was historical distribution.) In general, aside from minor habitat blockages, the TRT thought that habitat access in the original range would be similar to historical, although barriers on smaller tributaries may limit distribution.

North Fork Lewis River Coho Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	2.50	4.67	2.50	0.33	0.00	1.07	0.67
Juvenile outmigrants	0.83	3.33	2.17	0.33	0.00	0.87	0.83
Diversity	1.50	5.17	3.00	0.33	0.00	1.22	1.33
Habitat	2.33	4.83	2.33	0.50	0.00	1.10	2.17
Spatial structure	2.83	5.50	1.67	0.00	0.00	0.88	2.00

Weighted average: 1.07

Productivity and abundance: To estimate productivity, TRT members relied on limited abundance information and juvenile production estimates. Most information concerned production in Cedar Creek, the only large accessible tributary to the North Fork Lewis River.

JOM: A smolt trap on Cedar Creek provided some estimates of juvenile production, although TRT members who evaluated production considered juvenile production insufficient for long-term sustainability.

Diversity: Loss of natural production has reduced local adaptation. Furthermore, large releases of hatchery fish (many from the Cowlitz River basin) have eroded or overwhelmed native populations.

Habitat: Accessible habitat has been subjected to development effects. Many TRT members were concerned about the reliance on managed flow releases to ensure successful reproduction.

Spatial structure: Merwin Dam impedes access to most historical coho salmon range. Many lower basin tributaries are inaccessible due to small barriers. Additionally, dikes restrict access to or eliminate side channels.

East Fork Lewis River Coho Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	3.17	6.67	0.17	0.00	0.00	0.70	0.50
Juvenile outmigrants	1.50	8.00	0.50	0.00	0.00	0.90	1.00
Diversity	3.33	5.83	0.83	0.00	0.00	0.75	1.00
Habitat	3.17	3.50	3.00	0.33	0.00	1.05	2.17
Spatial structure	1.67	5.50	2.67	0.17	0.00	1.13	1.50

Weighted average: 0.84

Productivity and abundance: The majority of TRT members utilized limited abundance information rather than rely on the default score for no data. All TRT members considered this population to be at a very low probability of persistence.

JOM: Some juvenile information was available, although only a few TRT members evaluated the persistence probability for this criterion.

Diversity: The introduction of coho salmon from other basins within the ESU was thought to have negatively affected population persistence, specifically loss of local adaptation.

Habitat: TRT members considered much of the lower river moderately to severely impaired. Existing development and the likelihood of continued development were TRT concerns. Gravel mining in mainstem areas is another risk.

Spatial structure: Much of the basin is accessible, although small barriers may exist on side channels and the access to historical flood plains may be restricted.

Salmon Creek Coho Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	4.83	5.17	0.00	0.00	0.00	0.52	0.17
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	3.50	6.17	0.33	0.00	0.00	0.68	0.83
Habitat	5.50	4.50	0.00	0.00	0.00	0.45	2.33
Spatial structure	4.17	4.67	1.17	0.00	0.00	0.70	1.50

Weighted average: 0.56

Productivity and abundance: The majority of TRT members utilized the default score for no data (see Grays River population, page 72). The only available information was presence /absence information from Washington Department of Fish and Wildlife (WDFW) and redd counts from the late 1980s. All TRT members considered this population at very low probability of persistence.

Diversity: Poor habitat quality suggests that there is little natural reproduction, and direct hatchery transfers, although limited in absolute numbers, may have had a significant effect given the probable small size of the spawning population.

Habitat: Much of the basin is located in a highly developed urban and residential area. There is considerable habitat degradation and highly or moderately impaired riverine processes.

Spatial structure: Poor habitat conditions may limit accessibility. There may be a number of development-related barriers (e.g., culverts) on smaller tributaries. Additionally, the small population size may limit the population's potential to occupy much of the available habitat.

Washougal River Coho Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	5.00	5.00	0.00	0.00	0.00	0.50	0.00
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	2.83	6.00	1.17	0.00	0.00	0.83	1.00
Habitat	2.17	6.50	1.33	0.00	0.00	0.92	2.33
Spatial structure	3.50	5.17	1.17	0.17	0.00	0.80	1.83

Weighted average: 0.68

Productivity and abundance: TRT members utilized the default score for no data (see Grays River population, page 72).

Diversity: Introduction of nonnative fish, especially S-type coho salmon, may have substantially influence the genetic composition of coho salmon in the basin.

Habitat: Urbanization and residential development degraded reaches in the lower portion of the basin, and agriculture and forestry may have negatively influenced the upper reaches. Some TRT members highlighted the relatively good sections of the river in the basin's headwater areas.

Spatial structure: Poor habitat conditions may limit accessibility, although there were no major physical barriers to distribution.

Clackamas Coho Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	0.71	2.86	3.86	2.57	0.00	1.83	2.43
Juvenile outmigrants (5 members)	0.80	1.60	4.60	3.00	0.00	1.98	2.60
Diversity	0.57	2.57	4.43	2.29	0.14	1.89	1.57
Habitat	1.43	3.86	3.43	1.29	0.00	1.46	1.14
Spatial structure	0.43	2.71	4.29	2.57	0.00	1.90	1.43

Weighted average: 1.79

Productivity and abundance: TRT members noted the generally stable trend in abundance, along with moderate numbers of fish, although preharvest recruitment declined significantly in the 1990s. Some members were concerned about the high percentage of hatchery fish in the lower Clackamas River (below North Fork Dam) compared to the upper river.

JOM: The majority of TRT members considered information for evaluating the JOM criteria to be sufficient. Smolt outmigration monitoring indicates fairly stable productivity.

Diversity: Late-run coho salmon are presumed to be native, while early-run coho are primarily of hatchery origin. Hatchery fish predominate (78% of escapement) below the North Fork Dam, but are mostly prevented from ascending (only 12% of fish above the dam are of *known* hatchery origin). There was some fear that progeny of naturally spawning early-run coho salmon could ascend into the upper basin and might integrate with native late-run coho.

Habitat: Habitat conditions are poor in much of the habitat below North Fork Dam, but are relatively better above it. Residential and agricultural land use is widespread in the lower reaches of the Clackamas River and adjacent Kellogg and Johnson Creeks.

Spatial structure: Degraded habitat may result in dispersed patches of fish. Passage over dams and inundation of much of the main stem may further influence distribution of spawning adults.

Sandy River Coho Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	0.57	3.86	4.14	1.43	0.00	1.64	2.43
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	0.86	3.29	4.29	1.43	0.17	1.68	1.14
Habitat	0.71	3.86	4.29	1.71	0.00	1.76	1.43
Spatial structure	1.00	3.43	4.29	1.29	0.00	1.59	1.29

Weighted average: 1.66

Productivity and abundance: TRT members found the abundance trend for this population to be relatively stable (growth rate near 1); however, individual run years varied considerably, and the preharvest recruitment declined significantly in the 1990s. Hatchery releases contribute to the majority of spawners below Marmot. Sandy River Hatchery utilizes a broodstock that is thought to be somewhat representative of the native population.

JOM: Not rated.

Diversity: The large contribution of hatchery fish to escapement below the dam raised concerns that the progeny of naturally spawning hatchery fish could ascend Marmot Dam and interbreed with native late-run coho salmon once Marmot dam is removed.

Habitat: Conditions in the Sandy River basin below Marmot Dam are slightly to moderately impaired. Above Marmot Dam, habitat conditions are generally better than below, although timber harvest is a concern. Blockages of Bull Run and the Little Sandy River significantly reduce the overall productivity of the basin.

Spatial structure: Blockages of Bull Run and the Little Sandy River significantly reduce the distribution of coho salmon. Additionally, poor conditions in the lower river may reduce or restrict utilization by coho salmon.

Lower Columbia River Coho Salmon—Gorge Stratum

Lower Gorge Coho Salmon (Washington)

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	5.00	5.00	0.00	0.00	0.00	0.50	0.00
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	3.33	5.83	0.83	0.00	0.00	0.75	1.00
Habitat	2.50	5.33	2.17	0.00	0.00	0.97	2.17
Spatial structure	2.50	5.83	1.50	0.17	0.00	0.93	1.67

Weighted average: 0.69

Productivity and abundance: The TRT members utilized the default score for no data (see Grays River population, page 72).

Diversity: Releases from a number of hatcheries (using nonnative stocks) within this DIP’s tributaries have likely eroded the genetic diversity that historically existed. Natural reproduction is presumed to be relatively low.

Habitat: Except for Hamilton Creek, this DIP consists of relatively small tributaries to the Columbia River. Many of these tributaries have been moderately to highly degraded. Development in the transit corridor along the Columbia River appears to be related to most of the degradation.

Spatial structure: Hatchery weirs are a major barrier to distribution; additional small barriers may exist in the lower reaches of many tributaries.

Lower Gorge Coho Salmon (Oregon)

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	5.71	2.86	1.14	0.29	0.00	0.60	0.00
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	4.29	3.71	1.57	0.43	0.00	0.81	0.43
Habitat	1.43	3.43	4.00	1.00	0.14	1.50	1.29
Spatial structure	4.29	3.00	2.00	0.71	0.00	0.91	0.57

Weighted average: 0.84

Productivity and abundance: Representatives from ODFW provided anecdotal reports of coho salmon in this DIP. The overall abundance was presumed to be extremely low.

JOM: Not rated.

Diversity: Hatchery-origin fish were thought to significantly contribute to escapement. Little additional information is available.

Habitat: Due to waterfalls, only the lower reaches of lower Columbia Gorge tributaries to the Columbia River are accessible. Habitat conditions in these lower reaches are generally moderately degraded.

Spatial structure: Hatchery weirs may limit coho salmon distribution, although it was suggested that coho salmon can "get past" the weirs. Low numbers of spawning adults probably significantly affect distribution.

Upper Gorge Coho Salmon (Washington)

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	5.00	5.00	0.00	0.00	0.00	0.50	0.00
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	5.50	4.00	0.50	0.00	0.00	0.50	0.83
Habitat	1.33	4.67	3.33	0.67	0.00	1.33	1.83
Spatial structure	4.17	4.00	1.67	0.17	0.00	0.78	0.83

Weighted average: 0.69

Productivity and abundance: The TRT members utilized the default score for no data (see Grays River population, page 72).

Diversity: Hatchery introductions and the relatively poor performance of naturally produced coho salmon were cited as reasons for relatively low persistence ratings.

Habitat: Urbanization and residential development degraded reaches in the lower basin. Agriculture and forestry may have negatively influenced the basin's upper reaches. Some TRT members highlighted the relatively good sections of the river in the headwater areas.

Spatial structure: Poor habitat conditions and numerous small barriers may limit the distribution of coho salmon in this DIP.

Upper Gorge Coho Salmon (Oregon)

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	5.86	3.14	0.86	0.14	0.00	0.53	0.14
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	4.29	3.71	1.71	0.29	0.00	0.80	0.29
Habitat	1.86	4.43	3.29	0.43	0.00	1.23	1.29
Spatial structure	4.43	3.00	2.00	0.57	0.00	0.87	0.71

Weighted average: 0.75

Productivity and abundance: Other than anecdotal information, no abundance information was presented to the TRT. One member based the abundance evaluation on habitat quality.

JOM: Not rated.

Diversity: Large hatchery releases and the generally poor quality of the habitat led most TRT members to conclude that the naturally spawning population has likely been genetically modified with little opportunity for adaptation to local conditions.

Habitat: Much historical habitat was inundated by Bonneville Pool. What accessible habitat remains is moderately impaired.

Spatial structure: Loss of habitat due to Bonneville Dam, combined with poor habitat quality, affected fish distribution throughout this DIP. Additionally, the hatchery weir on Herman Creek may limit access to the upper reaches of this DIP's largest tributary.

Hood River Coho Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	5.29	3.71	0.71	0.29	0.00	0.60	1.14
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	3.14	3.57	2.43	0.86	0.00	1.10	1.00
Habitat	1.57	4.86	2.86	0.71	0.00	1.27	1.29
Spatial structure	2.57	3.57	2.57	1.00	0.00	1.17	1.00

Weighted average: 0.89

Productivity and abundance: Counts of returning adults at Powerdale Dam indicate that abundance has fallen to critically low levels.

JOM: Not rated.

Diversity: There have been few recent hatchery releases; however, many TRT members noted that the small escapement made the population readily susceptible to introgression by a small number of strays or loss of genetic diversity due to a population bottleneck.

Habitat: Conditions are moderately or severely impaired throughout most of the basin. Agriculture in the lower reaches and timber harvest in the upper reaches are factors affecting habitat quality.

Spatial structure: There are no major barriers to migration; the laddering of Punchbowl Falls may have even expanded the coho salmon range (see Kalama population for comments on range expansion). Irrigation water diversions and culverts in the lower basin potentially limit access to smaller tributaries.

Big White Salmon River Coho Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	5.00	5.00	0.00	0.00	0.00	0.50	0.17
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	7.83	2.17	0.00	0.00	0.00	0.22	1.50
Habitat	5.33	3.67	1.00	0.00	0.00	0.57	2.00
Spatial structure	9.17	0.83	0.00	0.00	0.00	0.08	1.83

Weighted average: 0.39

Productivity and abundance: The TRT members utilized the default score for no data (see Grays River population, page 72), although some members noted that this population was probably extirpated following construction of Condit Dam so the default score (which assumes that fish may exist but are not monitored) might not be appropriate.

Diversity: Hatchery introductions, the near absence of accessible spawning habitat, and the low probability of any successful natural reproduction suggest that much of the genetic diversity native to the Big White Salmon River is extirpated and was replaced by hatchery introductions.

Habitat: Nearly the entire historical spawning habitat for coho salmon is inaccessible behind Condit Dam. In evaluating the habitat criterion, many TRT members included habitat above the dam in their considerations.

Spatial structure: Condit Dam eliminated access to nearly the entire basin.

Lower Columbia River Chum Salmon—Coastal Stratum

Grays River Chum Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	0.50	3.50	4.67	1.17	0.00	1.63	2.33
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	0.33	3.00	3.67	3.17	0.00	1.98	2.00
Habitat	2.17	4.67	2.33	0.83	0.00	1.18	2.17
Spatial structure	1.17	4.50	3.50	0.83	0.00	1.40	2.00

Weighted average: 1.58

Productivity and abundance: TRT members noted that the long-term lambda was slightly less than 1, but over a shorter time series lambda was probably well higher than 1. Most members also considered the fact that the vast majority of spawners were of natural origin, and that absolute abundance was relatively high in the last few years. However, abundance was relatively low for the preceding decades.

Diversity: Hatchery introductions have been relatively small in scale and intermittent. Genetic analyses indicate that this population is distinct from coastal populations and other Columbia River populations.

Habitat: Habitat was moderately impaired, especially in the lower river reaches, which are most commonly used by chum salmon. Development is the source of degradation in the lower river, while land use practices (e.g., timber harvest) were identified in the upper reaches.

Spatial structure: Much historical range for chum salmon is accessible, although tide gates, culverts, and dikes probably limit access in the lower reaches. Spawner surveys indicate that the majority of chum salmon spawning is limited to a short stream reach, so microhabitats favorable to chum salmon may have limited distribution.

Elochoman River Chum Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	6.50	2.83	0.67	0.00	0.00	0.42	1.33
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	4.67	3.00	1.83	0.50	0.00	0.82	1.33
Habitat	3.33	5.50	1.17	0.00	0.00	0.78	2.17
Spatial structure	3.83	4.33	1.67	0.17	0.00	0.82	1.83

Weighted average: 0.61

Productivity and abundance: Until recently, abundance in this DIP was very low (0 in a number of years). Abundance information was limited and spawner surveys targeting chum salmon were undertaken only recently. Surveys in 2002 and 2003 detected a relatively prominent increase in population abundance. Many TRT members suggested that this increase was related to Grays River fish straying into adjacent basins.

Diversity: Very little information was available to describe life history traits or genetic variation. There have been a few substantial releases of chum salmon into this DIP, but the success of those releases is unknown (although there was little detectable increase in subsequent abundance). Low population abundance may have decreased genetic variability

Habitat: Habitat conditions were moderately to highly impaired in the lower reaches of the DIP that are frequented by chum salmon.

Spatial structure: Much chum salmon historical range is accessible, although tide gates, culverts, and dikes probably limit access in the lower reaches. Low abundance levels may further restrict the distribution of spawning chum salmon.

Mill Creek Chum Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	7.50	2.33	0.17	0.00	0.00	0.27	1.33
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	4.67	3.17	1.67	0.50	0.00	0.80	1.33
Habitat	3.67	5.67	0.67	0.00	0.00	0.70	2.17
Spatial structure	5.17	3.50	1.17	0.17	0.00	0.63	1.67

Weighted average: 0.49

Productivity and abundance: Spawner surveys have only recently begun to specifically count chum salmon. Few fish have been observed, except in the most recent years when good ocean conditions improved survival. The majority of TRT members suggested that any increase in abundance was likely due to straying from the Grays River.

Diversity: Very little information was available to describe life history traits or genetic variation. There have been limited releases of chum salmon into this DIP, but the success of those releases is unknown (although there was little detectable increase in subsequent abundance). Low population abundance may have decreased genetic variability

Habitat: Much of the habitat historically utilized by chum salmon is impacted by development (Longview and Kelso urban and suburban areas). These lower reaches are all generally moderately to highly impaired.

Spatial structure: Much chum salmon historical range is accessible, although tide gates, culverts, and dikes probably limit access in the lower reaches. The presence of three distinct creek basins may reduce the probability of catastrophic losses. Low abundance levels may further restrict the distribution of spawning chum salmon.

Youngs Bay Chum Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	7.57	2.29	0.14	0.00	0.00	0.26	0.57
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	5.43	3.57	1.00	0.00	0.00	0.56	0.71
Habitat	1.86	5.71	2.14	0.14	0.00	1.04	1.43
Spatial structure	4.43	4.00	1.43	0.14	0.00	0.73	0.71

Weighted average: 0.52

Productivity and abundance: Other than a few anecdotal reports, no chum salmon have been observed in the Youngs Bay area.

JOM: Not rated.

Diversity: No information is available. Based on low escapement, the potential for genetic loss is severe.

Habitat: Poor habitat conditions exist throughout the tributaries to Youngs Bay. Development and timber harvesting are sources of degradation.

Spatial structure: No major blockages were identified (although there was some discussion of the Klaskanine hatchery weir as a potential impediment). Numerous small blockages (tide gates, culverts) may impede access to smaller tributaries and side channels frequented by chum salmon.

Big Creek Chum Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	7.43	2.43	0.14	0.00	0.00	0.27	0.57
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	5.29	3.71	1.00	0.00	0.00	0.57	0.71
Habitat	2.29	5.29	2.14	0.14	0.00	1.00	1.43
Spatial structure	4.57	3.57	1.43	0.43	0.00	0.77	0.86

Weighted average: 0.53

Productivity and abundance: Chum salmon have been occasionally observed at the hatchery weir; recent returns have been at or near 0.

JOM: Not rated.

Diversity: Small population size increases the risk for genetic diversity loss, either through population bottlenecks or introgression by stray fish.

Habitat: Habitat conditions are moderately impaired throughout much of the basin. Agriculture in the lower basin and timber harvesting in the upper basin are habitat degradation factors.

Spatial structure: The Big Creek Hatchery weir may prevent access to the upper Big Creek basin. Dikes and agricultural diversions impair access to side channels and small tributaries.

Clatskanie River Chum Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	7.57	2.29	0.14	0.00	0.00	0.26	0.43
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	5.57	3.43	1.00	0.00	0.00	0.54	0.29
Habitat	3.57	4.57	1.57	0.14	0.00	0.81	1.43
Spatial structure	4.57	3.86	1.43	0.14	0.00	0.71	0.71

Weighted average: 0.47

Productivity and abundance: There was no direct information available for this population. The lack of observations suggests no or extremely few chum salmon.

JOM: Not rated.

Diversity: No information. Most members assumed that, if present, this population is at very low abundance, making it susceptible to genetic bottlenecks or introgression by stray adults.

Habitat: Conditions in the lower reaches of Columbia River tributaries in this DIP are heavily impacted by agriculture. Riparian conditions are severely impaired in these areas. Headwater areas are more impacted by timber harvesting, although the degree of habitat degradation is moderate relative to the lower reaches, which would be more closely associated with spawning adult and juvenile chum salmon.

Spatial structure: Dikes and tidal gates in lowland areas may have eliminated access to important side channels. Culverts may also limit access. Poor spatial structure is also related to low abundance.

Scappoose Chum Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	7.57	2.29	0.14	0.00	0.00	0.26	0.43
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	5.57	3.43	1.00	0.00	0.00	0.54	0.43
Habitat	3.86	4.57	1.29	0.14	0.00	0.76	1.43
Spatial structure	4.29	3.86	1.43	0.43	0.00	0.80	0.86

Weighted average: 0.48

Productivity and abundance: There is no current abundance information available. The majority of TRT members utilized a default score.

JOM: Not rated.

Diversity: No information. TRT members assumed that small population size increases the risk for genetic diversity loss, either through population bottlenecks or introgression by stray fish.

Habitat: Habitat conditions are severely or moderately impaired throughout the basin. Agriculture in the lower reaches and residential and urban development, are factors in habitat degradation.

Spatial structure: Historically, a number of small dams presented migrational barriers. How many of these structures still exist was unclear. Dikes and culverts eliminated access to side-channel habitat utilized by chum salmon. Most importantly, the low population size severely limits spatial structure.

Lower Columbia River Chum Salmon—Cascade Stratum

Cowlitz River Chum Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	7.50	2.50	0.00	0.00	0.00	0.25	0.83
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	6.00	1.50	1.33	1.17	0.00	0.77	1.33
Habitat	5.00	4.17	1.17	0.00	0.00	0.65	2.00
Spatial structure	7.00	2.33	0.67	0.00	0.00	0.37	1.33

Weighted average: 0.42

Productivity and abundance: Anecdotal reports indicate that a few chum salmon have been observed at the Cowlitz Salmon Hatchery for a number of years. Recent spawner surveys indicated the presence of a small number of fish. Some TRT members suggested that these fish might be strays from the Grays River.

Diversity: Cowlitz River chum salmon appear to express a "summer" run timing, earlier than Grays River or Hamilton and Hardy Creek chum salmon. Additionally, preliminary genetic analysis indicates that Cowlitz River chum salmon may be distinct from other Columbia River populations. The TRT was cautioned that further sampling is needed to verify this finding.

Habitat: Much habitat historically utilized by chum salmon is impacted by development, especially below Castle Rock. Lower reaches are moderately to highly impaired, and much historical floodplain is lost.

Spatial structure: Much historical chum salmon range is accessible, although tide gates, culverts, and dikes probably limit access in the lower reaches.

Kalama River Chum Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	8.00	1.83	0.17	0.00	0.00	0.22	1.00
JOM	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	8.00	1.33	0.67	0.00	0.00	0.27	0.83
Habitat	4.67	5.00	0.33	0.00	0.00	0.57	2.17
Spatial structure	7.50	2.00	0.50	0.00	0.00	0.30	2.00

Weighted average: 0.30

Productivity and abundance: Few chum salmon have been observed in the Kalama River. There is little information to evaluate the population's status.

Diversity: No current information is available.

Habitat: Much habitat historically utilized by chum salmon is impacted by development. Lower reaches are all generally moderately to highly impaired due to urbanization.

Spatial structure: Much historical chum salmon range is accessible, although tide gates, culverts, and dikes probably limit access in the lower reaches. Low abundance levels may further restrict the distribution of spawning chum salmon.

Lewis River Chum Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	7.50	2.50	0.00	0.00	0.00	0.25	1.00
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	6.17	3.00	0.83	0.00	0.00	0.47	1.00
Habitat	4.17	4.17	1.50	0.17	0.00	0.77	2.17
Spatial structure	6.17	2.67	1.00	0.17	0.00	0.52	1.67

Weighted average: 0.42

Productivity and abundance: Spawner surveys targeting late-run Chinook salmon have incidentally observed chum salmon on a consistent basis, but at a very low level of abundance in the North Fork Lewis River. Recent surveys of the East Fork Lewis River report very low numbers of spawning chum salmon.

Diversity: There is little information on life history characteristics of chum salmon spawning in the Lewis River. Hatchery influence has been minimal. Preliminary genetic information suggests that this population is distinct, but the small number of samples may influence this finding.

Habitat: Much of the North Fork Lewis River is inaccessible to chum salmon because of Merwin Dam. Development has affected the lower reaches and controlled water releases for spawning Chinook salmon probably benefit chum salmon. Some TRT members were concerned that water releases from Merwin Dam could be better managed to benefit salmon. Conditions in the East Fork are affected by development and land use (gravel mining).

Spatial structure: Much of the historical chum salmon range in the North Fork is inaccessible. Furthermore, culverts and dikes probably limit access in the lower reaches. Low abundance levels may further restrict the distribution of spawning chum salmon. Additionally, water releases from Merwin Dam may concentrate spawners and make them more susceptible to catastrophic events.

Salmon Creek Chum Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	9.33	0.67	0.00	0.00	0.00	0.07	0.67
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	7.83	1.83	0.33	0.00	0.00	0.25	1.00
Habitat	6.67	3.17	0.17	0.00	0.00	0.35	2.33
Spatial structure	7.83	1.83	0.17	0.17	0.00	0.27	1.67

Weighted average: 0.18

Productivity and abundance: No information is available. Few spawner surveys are conducted in this area, and there have been no recent chum salmon observations.

JOM: Not rated.

Diversity: No current information is available.

Habitat: Development in and around Vancouver severely degraded this basin.

Spatial structure: A paucity of spawning adults and poor habitat conditions may disrupt the distribution of fish (if fish are actually present). Culverts may further restrict access to historical spawning areas.

Washougal River Chum Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	5.67	4.17	0.17	0.00	0.00	0.45	1.33
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	3.50	5.00	1.00	0.50	0.00	0.85	1.00
Habitat	4.67	4.17	1.00	0.17	0.00	0.67	1.83
Spatial structure	4.67	3.50	1.67	0.17	0.00	0.73	1.83

Weighted average: 0.60

Productivity and abundance: This DIP includes fish spawning near the I-205 groundwater seeps. Spawner surveys indicated a considerable increase in adult abundance in the last 2 years; prior to that, anecdotal information suggested a relatively small spawning aggregation.

Diversity: Genetic information associated this population with chum salmon in the lower Columbia Gorge DIP. Spawn timing and age structure are similar to historical information. Some TRT members were concerned that low population abundance in the past may have created a bottleneck that limited genetic diversity.

Habitat: Urbanization and development along the transit corridor are major factors in habitat degradation. Conditions in the lower reaches of the Washougal River are moderately or highly impaired.

Spatial structure: A paucity of spawning adults and poor habitat conditions may disrupt fish distribution (if fish are actually present). Groundwater spawning sites may produce isolated pockets of spawning adults.

Clackamas River Chum Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	7.71	2.14	0.14	0.00	0.00	0.24	0.29
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	5.86	3.14	1.00	0.00	0.00	0.51	0.43
Habitat	3.86	4.71	1.43	0.00	0.00	0.76	1.43
Spatial structure	5.14	3.43	1.29	0.14	0.00	0.64	0.86

Weighted average: 0.44

Productivity and abundance: Chum salmon were extirpated in the 1930s; whether this population is reestablished is unclear. No current information documents the presence of chum salmon in this basin.

JOM: Not rated.

Diversity: If chum salmon are present they would be the descendants of those that recolonized the basin. Founder effects and continuing small population size (bottlenecks) would have probably constrained diversity.

Habitat: Habitat conditions in the lower river are strongly influenced by urbanization in the Portland metropolitan area. Agricultural lands extend throughout much of the presumptive historical range of chum salmon. Conditions are severely or moderately impaired throughout, and projected population growth will put further pressure on chum salmon habitat.

Spatial structure: Numerous road crossings and associated culverts probably restrict spatial structure. The critically low population size potentially restricts any spatial structure.

Sandy River Chum Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	7.57	2.29	0.14	0.00	0.00	0.26	0.29
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	5.57	3.43	1.00	0.00	0.00	0.54	0.29
Habitat	2.86	4.71	2.00	0.43	0.00	1.00	1.29
Spatial structure	4.71	3.29	1.57	0.43	0.00	0.77	0.86

Weighted average: 0.51

Productivity and abundance: No information. The lack of chum salmon observations suggests no or extremely few chum salmon.

JOM: Not rated.

Diversity: The presumed small population size increases the risk for genetic diversity loss, either through population bottlenecks or introgression by stray fish.

Habitat: Habitat conditions are moderately or severely impaired in the lower reaches of the Sandy River. Urbanization and agriculture predominate in the impaired areas. Upper reaches are in relatively good condition, although habitat in Bull Run and Little Sandy River are no longer accessible.

Spatial structure: Impassable structures on Bull Run and the Little Sandy River eliminate access to presumptive historical chum salmon habitat. Low population abundance also limits spatial structure.

Lower Columbia River Chum Salmon—Columbia Gorge Stratum

Lower Gorge Chum Salmon (Washington)

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	1.17	5.17	3.00	1.00	0.00	1.42	2.17
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	1.83	3.50	4.00	0.67	0.00	1.35	1.50
Habitat	1.83	4.33	3.33	0.50	0.00	1.25	2.17
Spatial structure	1.50	4.00	4.17	0.33	0.00	1.33	1.83

Weighted average: 1.36

Productivity and abundance: TRT members noted the strongly positive short-term trend in abundance and the somewhat moderate numbers of fish present over the longer term. Another factor is the absence of hatchery-origin fish in this population.

Diversity: A relatively comprehensive set of life history and genetics data are available on fish spawning in Hamilton and Hardy Creeks and below Bonneville Dam (Ives Island). This population is genetically distinct from the Grays River DIP and expresses life history traits that are similar to available historical observations.

Habitat: The lower portions of most creeks are moderately impaired, although the upper reaches of Hamilton Creek (the largest in this DIP) are in relatively good condition. Some TRT members noted that the reproductive success of fish at Ives Island depends on flow regulation at Bonneville Dam.

Spatial structure: A number of spawning aggregations are spread throughout the DIP, both in the creeks and in the main stem. Access to most areas is similar to historical, although culverts in the lower reaches of some streams may limit access.

Lower Gorge Chum Salmon (Oregon)

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	3.43	3.57	2.57	0.43	0.00	1.00	0.86
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	1.86	3.57	3.57	1.00	0.00	1.37	1.14
Habitat	1.57	4.57	3.57	0.29	0.00	1.26	1.29
Spatial structure	1.86	3.57	3.57	1.00	0.00	1.37	1.00

Weighted average: 1.17

Productivity and abundance: The TRT was provided with personal knowledge of recent spawner surveys. The 2003 return was estimated at 7,000 spawners in the mainstem Columbia River and Oregon tributaries. Previous years' returns were thought to be much smaller, although earlier surveys were not very intensive and not directed toward chum salmon.

JOM: Not rated.

Diversity: No specific information was available for fish on the Oregon side of this DIP, although they were presumed to be similar to fish spawning near Ives Island and Hamilton and Hardy Creeks.

Habitat: Conditions in the tributaries are generally good, with moderate impairment in the lowest reaches. Impairment in these areas may be related to the transit corridor that runs along the Columbia River. Releases of water from Bonneville Dam during spawning and incubation periods may influence the reproductive success of mainstem spawning chum salmon.

Spatial structure: In previous years, small population abundance likely limited spatial structure.

Upper Gorge Chum Salmon (Washington)

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	9.50	0.50	0.00	0.00	0.00	0.05	1.00
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	8.67	1.33	0.00	0.00	0.00	0.13	1.17
Habitat	6.67	2.67	0.50	0.17	0.00	0.42	1.83
Spatial structure	7.33	1.83	0.67	0.17	0.00	0.37	1.83

Weighted average: 0.18

Productivity and abundance: The most complete information is Bonneville Dam counts, although many fish that ascend Bonneville Dam are thought to fall back to spawning areas below it. A few carcasses have been recovered above Bonneville Dam. There were no known spawning aggregations.

Diversity: No current information was available.

Habitat: Much of the chum salmon habitat was lost with the filling of the Bonneville Pool. Furthermore, culverts and stream modifications on the transit corridor on the Washington side of the Columbia River may limit access for the few chum salmon that may be present.

Spatial structure: Bonneville Pool eliminated spawning habitat in both the main stem and lower creek reaches, creating a series of disconnected spawning sites. Low abundance may further restrict population dispersal.

Upper Gorge Chum Salmon (Oregon)

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	6.71	2.86	0.43	0.00	0.00	0.37	0.86
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	4.57	3.86	1.57	0.00	0.00	0.70	0.57
Habitat	2.57	5.29	2.00	0.14	0.00	0.97	1.29
Spatial structure	4.29	4.00	1.57	0.14	0.00	0.76	0.86

Weighted average: 0.59

Productivity and abundance: No data are available in the informational literature for this DIP, although some TRT members shared information on the passage of chum salmon over Bonneville Dam. In general, a few chum salmon are observed moving over the dam. Many chum salmon that ascend the dam are thought to fall back later and spawn below it.

JOM: Not rated.

Diversity: Small population size increases the risk for genetic diversity loss, either through population bottlenecks or introgression by stray fish.

Habitat: Bonneville Pool eliminated several kilometers of tributaries. Habitat conditions are severely or moderately degraded in many of the accessible tributaries.

Spatial structure: Inundation of historical spawning habitat (both in the lower reaches of most tributaries and in the main stem) fragmented the spatial structure of this DIP. Low population size further reduces the poor spatial structure.

Lower Columbia River Steelhead—Cascade Stratum Winter Run

Lower Cowlitz River Winter Steelhead

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	3.00	4.00	3.00	0.00	0.00	1.00	0.17
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	1.00	5.17	3.17	0.67	0.00	1.35	1.50
Habitat	2.17	6.17	1.67	0.00	0.00	0.95	2.33
Spatial structure	0.83	4.17	4.33	0.67	0.00	1.48	1.50

Weighted average: 1.13

Productivity and abundance: Winter steelhead spawn throughout much of the lower Cowlitz River; however, in the absence of recent spawner surveys, TRT members utilized the 3, 4, 3, 0, 0 default score for persistence categories 0–4 respectively. The distribution of these persistence ratings acknowledges the likely presence of steelhead, given the difficulty of surveying during winter high-flow months and the distribution of steelhead in less accessible side channels and small tributaries.

JOM: Not rated.

Diversity: Hatchery-origin fish comprise up to 92% of the naturally spawning individuals. The late-run winter hatchery stock utilized is thought to be representative of historically occurring winter steelhead. Genetic information is consistent with the hatchery population being part of the ESU.

Habitat: Modifications to much of the lower river—dikes, culverts, and land development—degraded habitat conditions and impaired stream processes. Furthermore, releases from Mayfield Dam may negatively influence river conditions during low-flow periods and restrict beneficial high flows.

Spatial structure: Much historical range is still accessible; however, confinement of the Cowlitz lower reaches within dikes may have eliminated side-channel habitats.

Coweeman River Winter Steelhead

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	1.50	5.83	2.67	0.00	0.00	1.12	1.50
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	0.50	6.33	2.83	0.33	0.00	1.30	1.33
Habitat	1.50	4.50	3.83	0.17	0.00	1.27	2.17
Spatial structure	0.67	5.17	3.67	0.50	0.00	1.40	1.83

Weighted average: 1.22

Productivity and abundance: Most TRT members noted the low lambda for this population, in addition to the relatively low total abundance. The contribution by hatchery fish is thought to be relatively significant.

Diversity: Only 27% of spawning adults are of natural origin. There have been numerous introductions of nonnative, early-run winter steelhead. Genetic information confirms the introgression of nonnative fish into the population.

Habitat: TRT members observed that conditions are moderately degraded throughout much of the basin, except for the lower reaches, where habitat degradation is more severe. Timber activities also degrade the upper basin.

Spatial structure: In general, access is fairly good, except in the lower reaches where side channels and tributaries may have been excluded due to dikes and culverts.

South Fork Toutle River Winter Steelhead

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	0.67	4.83	3.83	0.67	0.00	1.45	2.00
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	0.00	2.67	6.17	1.17	0.00	1.85	1.83
Habitat	1.33	3.17	4.00	1.50	0.00	1.57	2.17
Spatial structure	0.17	3.00	4.33	2.50	0.00	1.92	1.83

Weighted average: 1.61

Productivity and abundance: Most TRT members mentioned a decreasing trend (lambda) for this population as a risk to persistence; however, present moderate spawner abundance is viewed as a positive factor. The hatchery contribution to escapement is thought to be relatively low.

Diversity: Hatchery releases have likely had a relatively small influence on the spawning population. Genetic analysis indicates that this population is similar to other native populations in this ESU.

Habitat: Hydrologic processes are moderately impaired throughout much of the basin. The effects of the Mount St. Helens eruption are less apparent in the South Fork Toutle than in the North Fork Toutle. Much of the upper basin appears to be recovering from eruption effects.

Spatial structure: Distribution appears to be relatively good, with access to much of the historical range. Complete information on connectivity was lacking.

North Fork Toutle River Winter Steelhead

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	1.50	4.00	3.50	1.00	0.00	1.40	1.83
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	1.83	4.17	3.17	0.83	0.00	1.30	1.67
Habitat	3.50	3.83	2.33	0.33	0.00	0.95	2.00
Spatial structure	1.67	5.50	2.50	0.33	0.00	1.15	1.67

Weighted average: 1.27

Productivity and abundance: This population was marked by a relatively good upward trend (lambda), which is apparently due to the low absolute abundance (especially following the Mount St. Helens eruption).

Diversity: Hatchery introductions (early- and late-run winter steelhead and summer steelhead) following the Mount St. Helens eruption may have influenced this population's genetic composition. Some TRT members were concerned about the loss of diversity due to a population bottleneck in the post-eruption years. EDT analysis also indicates a reduction in habitat diversity, which would restrict the expression of life history traits.

Habitat: Mount St. Helens impacts continue throughout the basin, although a number of TRT members indicated that habitat conditions appear to be improving.

Spatial structure: Poor habitat conditions still restrict access to much historical habitat. Passage is also restricted by a number of debris dams.

Upper Cowlitz River Winter Steelhead

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	8.00	1.83	0.17	0.00	0.00	0.22	2.67
Productivity (w/passage)	*4.00*	*5.50*	*0.50*	*0.00*	*0.00*	*0.80*	*2.00*
Juvenile outmigrants (w/passage)	*6.00*	*4.00*	*0.00*	*0.00*	*0.00*	*0.13*	*2.00*
Diversity	3.17	4.67	1.83	0.33	0.00	0.93	1.67
Habitat	6.83	2.00	1.17	0.00	0.00	0.43	2.67
Habitat (w/passage)	*0.50*	*6.00*	*3.50*	*0.00*	*0.00*	*1.30*	*2.00*
Spatial structure	8.17	1.67	0.17	0.00	0.00	0.20	2.50

Weighted average: 0.36

Productivity and abundance: Until recently, there was no access above Mayfield Dam. Juvenile collection at the Cowlitz Falls facility is still relatively experimental, and collection success is generally low and quite variable. Many TRT members considered the trap-and-haul program to be experimental, with little available evidence that fish spawning in the upper Cowlitz

River contributed to adult recruits (these members awarded all 10 points to the 0 persistence category). Other TRT members indicated that there was enough information to suggest that fish spawning in the upper Cowlitz River were successfully reproducing and would likely contribute to escapement (these scores are broken out as "Productivity (w/passage)" in the table above).

JOM: The TRT members that considered spawners above Mayfield Dam also evaluated juvenile production from adults that passed above the dam. They noted low passage efficiency and low absolute numbers of juveniles.

Diversity: There was considerable variability in how TRT members evaluated this criterion. Some considered the population extirpated, some considered the population extirpated in its historical range but existing in a modified form in the Cowlitz Trout Hatchery late-run broodstock, and others considered the fish spawning in the upper Cowlitz (mostly of hatchery origin).

Habitat: Most TRT members considered the historical habitat for this population to be "effectively" inaccessible. Other members evaluated the habitat above Mayfield Dam based on their conclusion that steelhead had access (albeit limited) and were reproductively successful.

Spatial structure: The TRT members that considered the upper Cowlitz inaccessible gave spatial structure 10 points in the 0 persistence category. The remaining members primarily focused on the efficiency of the juvenile collection facility at Cowlitz Falls. Habitat accessibility in the upper Cowlitz River itself is thought to be fairly good.

Cispus River Winter Steelhead

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	8.00	1.83	0.17	0.00	0.00	0.22	2.67
Productivity (w/passage)	*4.00*	*5.50*	*0.50*	*0.00*	*0.00*	*0.80*	*2.00*
Juvenile outmigrants (w/passage)	*6.00*	*4.00*	*0.00*	*0.00*	*0.00*	*0.20*	*2.00*
Diversity	3.17	4.50	2.00	0.33	0.00	0.95	1.67
Habitat	6.83	1.67	1.50	0.00	0.00	0.47	2.67
Habitat (w/passage)	*0.50*	*5.00*	*4.50*	*0.00*	*0.00*	*1.40*	*2.00*
Spatial structure	8.17	1.67	0.17	0.00	0.00	0.20	2.50

Weighted average: 0.35

Productivity and abundance: Until recently, there was no access above Mayfield Dam. Juvenile collection at the Cowlitz Falls facility is still relatively experimental, and collection success is generally low and quite variable. Many TRT members considered the trap-and-haul program to be experimental, with little available evidence that fish spawning in the Cispus River contribute to adult recruits (these members awarded all 10 points to the 0 persistence category). Other TRT members indicated that there was enough information to suggest that fish spawning in the Cispus River successfully reproduce and likely contribute to escapement (these scores are broken out as "Productivity (w/passage)" in the table above).

JOM: The TRT members that considered spawners above Mayfield Dam also evaluated the juvenile production from adults that pass above the dam. They noted low passage efficiency and low absolute numbers of juveniles.

Diversity: There was considerable variability in how TRT members evaluated this criterion. Some considered the population extirpated, some considered the population extirpated in its historical range but existing in a modified form in the Cowlitz Trout Hatchery late-run broodstock, while others considered the fish spawning in the Cispus (mostly of hatchery origin).

Habitat: Most TRT members considered this population's historical habitat "effectively" inaccessible. Other members evaluated the habitat above Mayfield Dam based on their conclusion that steelhead had access (albeit limited) and were reproductively successful.

Spatial structure: The TRT members that considered the Cispus River inaccessible rated spatial structure with 10 points in the 0 persistence category. The remaining members primarily focused on the efficiency of the Cowlitz Falls juvenile collection facility. Habitat accessibility in the Cispus River itself is thought to be fairly good.

Tilton River Winter Steelhead

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	9.67	0.33	0.00	0.00	0.00	0.03	2.33
Juvenile outmigrants	10.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	5.33	3.50	1.17	0.00	0.00	0.58	1.33
Habitat	7.83	2.00	0.17	0.00	0.00	0.23	2.00
Habitat (w/passage)	*3.50*	*6.00*	*0.50*	*0.00*	*0.00*	*0.70*	*2.00*
Spatial structure	9.67	0.33	0.00	0.00	0.00	0.03	1.50

Weighted average: 0.15

Productivity and abundance: Reintroduction programs for steelhead in the Tilton River are not as advanced as in the Cispus or upper Cowlitz Rivers. Most TRT members considered this population to be extirpated in its historical range, although one member considered that the potential for a restoration program merited an 8, 2, 0, 0, 0 score rather than placing all 10 points in the 0 persistence category.

JOM: Absent any detectable reproduction most members did not score this category, although some indicated a very low persistence probability, with all points in the 0 category.

Diversity: There was considerable variability in how TRT members evaluated this criterion. Some considered the population extirpated, some considered the population extirpated in its historical range but existing in a modified form in the Cowlitz Trout Hatchery late-run broodstock.

Habitat: Most TRT members considered this population's historical habitat "effectively" inaccessible. Other members evaluated the habitat above Mayfield Dam based on their conclusion that steelhead have limited access to the Tilton River basin. Habitat impaired due to timber harvesting was specifically mentioned as a factor in habitat quality.

Spatial structure: Most TRT members considered the Tilton River inaccessible.

Kalama River Winter Steelhead

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	0.33	3.17	5.50	1.00	0.00	1.72	2.33
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	0.80	4.20	4.00	1.00	0.00	1.50	1.33
Habitat	0.33	5.00	3.83	0.83	0.00	1.52	1.83
Spatial structure	0.17	2.17	4.17	3.17	0.33	2.13	2.17

Weighted average: 1.68

Productivity and abundance: TRT members noted that the lambda for this population is about 1, and that abundance is moderate, with recent improvements in escapement. The predominance of natural-origin spawners in recent years was generally seen as a good indicator of sustainability.

JOM: Not rated.

Diversity: Hatchery fish contribute about one-third of escapement and to improvement over recent years. There have been numerous introductions of nonnative hatchery fish (both winter and summer run) into the basin. Genetic analysis indicates some introgression by these nonnative populations. Life history traits are generally similar to available historical information.

Habitat: Conditions throughout most of the basin are moderately impaired. Land development is prevalent throughout most of the lower reaches and timber harvest activities appear to be related to degradation in the upper basins.

Spatial structure: Spatial structure may be somewhat limited in the lower reaches (culverts, dikes, etc.), but overall accessibility is thought to be similar to historical levels. The laddering of Kalama Falls may have extended this population's distribution, although it was not apparent that winter-run steelhead utilize much habitat above the falls.

North Fork Lewis River Winter Steelhead

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	3.67	4.00	2.33	0.00	0.00	0.87	0.33
Juvenile outmigrants (1 TRT member)	10.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	3.00	5.17	1.83	0.00	0.00	0.88	1.83
Habitat	3.00	4.17	2.33	0.50	0.00	1.03	2.33
Spatial structure	4.17	5.33	0.50	0.00	0.00	0.63	2.00

Weighted average: 0.86

Productivity and abundance: Most TRT members utilized the default score for "no data" of 3, 4, 3, 0, 0; however, one member considered escapement to Cedar Creek, a tributary to the North Fork Lewis River, in the evaluation.

JOM: One TRT member noted that there is some information on JOM from the Cedar Creek trap, but it was not available at the TRT review meeting.

Diversity: There have been a number of introductions into the North Fork Lewis River. Genetic analysis suggests that there may be some introgression between introduced early-run winter steelhead and native late-run winter steelhead.

Habitat: Merwin Dam blocks access to much (80%) of the winter steelhead historical habitat. Cedar Creek provides the majority of available spawning area. Development in the accessible lower reaches degraded conditions and hydrologic processes.

Spatial structure: Merwin Dam blocks 80% of the historical habitat. Dikes and river-bank modifications modified access to aside channels and small tributaries in the lower river.

East Fork Lewis River Winter Steelhead

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	3.17	4.00	2.33	0.50	0.00	1.02	1.17
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	1.00	3.83	4.17	1.00	0.00	1.52	1.67
Habitat	1.50	3.83	3.67	0.83	0.00	1.37	2.33
Spatial structure	0.83	2.33	4.67	2.17	0.00	1.82	2.00

Weighted average: 1.29

Productivity and abundance: Only a limited abundance time series is available for this population. The lambda is negative, although with recent improvements in escapements this may turn positive (if current ocean conditions continue).

JOM: Not rated.

Diversity: The introduction of hatchery fish diminished in recent years; current escapement consists mostly of natural fish. TRT members also noted that genetic analysis confirms that nonnative introductions have not influenced this population's genetic diversity.

Habitat: Conditions, especially in the lower river reaches, are subject to development impacts. Habitat degradation is less severe in the upper basin.

Spatial structure: Access is generally thought to be good throughout the basin, with minor blockages (especially in the lower river).

Salmon Creek Winter Steelhead

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	3.00	4.00	3.00	0.00	0.00	1.00	0.00
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	5.00	4.17	0.83	0.00	0.00	0.58	0.50
Habitat	5.17	3.83	1.00	0.00	0.00	0.58	2.33
Spatial structure	2.00	4.00	3.33	0.67	0.00	1.27	1.50

Weighted average: 0.91

Productivity and abundance: Most TRT members utilized the no data default, while one TRT member considered the population extirpated.

JOM: Not rated.

Diversity: Most TRT members thought that few wild fish remained in the population and that most remaining fish were either of hatchery-origin or descendants of hatchery introductions.

Habitat: Conditions throughout most of the basin are severely impaired. Land development and urbanization around Vancouver have resulted in considerable habitat degradation.

Spatial structure: Numerous road crossings, stream modifications, and patches of highly degraded habitat all limit connectivity.

Washougal River Winter Steelhead

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	3.33	5.33	1.33	0.00	0.00	0.80	1.50
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	1.50	4.33	2.00	0.50	0.00	0.98	1.17
Habitat	2.00	4.83	2.83	0.17	0.00	1.10	2.33
Spatial structure	1.83	6.00	1.67	0.50	0.00	1.08	2.17

Weighted average: 0.93

Productivity and abundance: Only a short time series of abundance information is available for this population. The trend is positive, although some TRT members noted that absolute abundance is still low.

JOM: Not rated.

Diversity: The current contribution of hatchery fish to escapement is unclear. Historically, there have been a number of winter-run introductions, but the longer-term impact of those transfers is not clear (a number of TRT members suggested temporal segregation).

Habitat: The lower reaches of the Washougal basin are negatively influenced by land development and agriculture. The upper reaches are in relatively better condition (although many of these areas are naturally inaccessible).

Spatial structure: Access is generally good, except in the lower reaches where dikes and road crossings limit access to side channels and smaller tributaries.

Clackamas River Winter Steelhead

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	1.25	4.13	3.38	1.25	0.00	1.46	2.13
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	NR
Diversity	0.88	3.88	3.88	1.38	0.00	1.58	1.43
Habitat	1.29	3.14	3.86	1.71	0.00	1.60	1.43
Spatial structure	0.75	3.63	3.75	1.88	0.00	1.68	1.29

Weighted average: 1.54

Productivity and abundance: TRT members acknowledged the downward long-term trend (although the short-term trend is positive, due to improving ocean conditions). Average abundance is near 1,000 fish. Production is mostly natural, although the hatchery program may contribute significantly to production.

JOM: Juvenile information exists but was not presented. Recruits per spawner are still less than 1.

Diversity: Currently, the local hatchery broodstock is largely native in origin. There have been a number of introductions in the past from outside the DIP but within the ESU. Existing population is a late winter steelhead (thought to be the native run timing, rather than early-winter hatchery fish from the Southwest Washington ESU).

Habitat: Urbanization and related land development has severely degraded habitat in the lower basin. Agriculture also impairs conditions in the lower reaches of the basin. Headwater areas, especially those in federal forest lands appear to be in relatively good condition.

Spatial structure: Development in the lower basin (culverts at road crossings, dikes, and bank armoring) probably restricts access to smaller tributaries. Upstream and downstream passage through the North Fork Dam complex may be partially blocked or delayed.

Sandy River Winter Steelhead

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	1.13	4.00	3.88	1.00	0.00	1.48	2.13
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	1.00	3.88	3.63	1.50	0.00	1.56	1.13
Habitat	0.29	3.71	4.14	1.86	0.00	1.76	1.43
Spatial structure	1.50	4.38	3.25	0.88	0.00	1.35	1.13

Weighted average: 1.52

Productivity and abundance: Abundance ranges between 500 and 1000 fish, based on counts at Marmot Dam. ODFW personnel estimated that 80% of steelhead spawning is above Marmot Dam. The long-term trend is negative.

JOM: Not rated.

Diversity: Large numbers of hatchery-origin fish have been released into the Sandy River basin. Many of them originated from Big Creek (Southwest Washington ESU) or Skamania Hatchery (multiple ESU origin). Efforts to remove hatchery fish at Marmot Dam may reduce the risk of introgression. TRT members were concerned that the progeny of naturally spawning hatchery-origin fish would be indistinguishable from native steelhead.

Habitat: Conditions in the lower Sandy River basin are negatively influenced by urbanization and agriculture. Impassable dams on the Bull Run and Little Sandy River eliminate access to two large tributary basins. Conditions above Marmot Dam are generally good. Federal ownership of the upper basin was thought to ensure that existing conditions will be carried into the future.

Spatial structure: The dams on Bull Run and the Little Sandy River eliminate access to a considerable portion of the historical range.

Lower Columbia River Steelhead—Cascade Stratum Summer Run

Kalama River Summer Steelhead

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	1.50	4.50	3.67	0.33	0.00	1.28	2.17
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	0.33	3.83	4.83	1.00	0.00	1.65	2.00
Habitat	0.17	4.33	4.33	1.17	0.00	1.65	2.17
Spatial structure	0.00	2.67	5.00	2.17	0.17	1.98	2.33

Weighted average: 1.52

Productivity and abundance: Abundance information for this population is relatively good. Although the long-term trend (lambda) is less than 1, the short-term trend is strongly positive. Hatchery contribution is well documented. Absolute abundance is low to moderate.

JOM: Not rated.

Diversity: Hatchery fish comprise approximately one-third of escapement. Genetic analysis indicates that nonnative hatchery introductions (Skamania Hatchery summer-run steelhead) have made a minimal impact on the genetic composition of this population (perhaps through temporal separation at spawning).

Habitat: The upper Kalama basin is in relatively good condition, with river processes moderately impaired in some reaches. More severe degradation was identified in the lower reaches, which serve primarily as the migration corridor and provide some juvenile rearing habitat.

Spatial structure: Accessibility is generally thought to be adequate throughout much of the upper basin.

North Fork Lewis River Summer Steelhead

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	4.50	3.50	2.00	0.00	0.00	0.75	0.67
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	6.00	3.67	0.33	0.00	0.00	0.43	1.17
Habitat	5.83	3.17	1.00	0.00	0.00	0.52	2.33
Spatial structure	5.83	4.00	0.17	0.00	0.00	0.43	2.17

Weighted average: 0.61

Productivity and abundance: Some TRT members utilized the no data default, while others considered the population effectively extirpated. Only 7% of escapement is of natural origin (this suggests that any summer steelhead spawning in the North Fork Lewis River are not successful).

JOM: Not rated.

Diversity: The near absence of naturally produced fish limits this population's ability to adapt to local conditions. The construction of Merwin Dam and the introduction of large numbers of nonnative summer-run steelheads may have dramatically changed this population's genetic composition.

Habitat: Merwin Dam eliminated access to summer steelhead spawning habitat. Cedar River habitat is not suitable for summer-run steelhead. Although some summer-run steelhead may spawn in the lower Lewis River, it is unlikely that there is any contribution to the population's sustainability.

Spatial structure: All of the spawning habitat and most rearing habitat is inaccessible.

East Fork Lewis River Summer Steelhead

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	1.00	4.50	4.00	0.50	0.00	1.40	1.67
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	0.33	3.50	4.67	1.50	0.00	1.73	1.83
Habitat	1.67	4.50	3.17	0.67	0.00	1.28	2.17
Spatial structure	0.67	4.33	3.83	1.17	0.00	1.55	1.83

Weighted average: 1.46

Productivity and abundance: TRT members noted the positive trend (lambda), although many added that the time series is rather short and strongly influenced by recent improvements in ocean conditions. Total abundance is still not very high.

JOM: Not rated.

Diversity: Hatchery fish make up a substantial portion of the escapement; however, genetic analysis indicates that there has been relatively little introgression between the native summer steelhead and the hatchery (Skamania hatchery) steelhead.

Habitat: The upper East Fork Lewis River is in relatively good condition, with moderately impaired hydrologic processes in some reaches. The lower reaches are degraded from land development (residential and agricultural).

Spatial structure: Distribution is similar to historical; modifications to the main channel in the lower reaches may limit diversity.

Washougal River Summer Steelhead

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	1.17	4.17	3.67	1.00	0.00	1.45	1.83
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	1.00	4.67	3.17	1.17	0.00	1.45	1.83
Habitat	2.00	3.33	3.67	1.00	0.00	1.37	2.33
Spatial structure	1.50	4.17	3.00	1.33	0.00	1.42	2.17

Weighted average: 1.43

Productivity and abundance: The trend for this population is relatively stable (lambda = 1) but short in duration.

JOM: Not rated.

Diversity: Hatchery introductions have been fairly substantial, although genetic analysis indicates that the existing population probably retains a native composition.

Habitat: The upper portion of the Washougal River basin (predominately utilized by summer-run steelhead) is in relatively good condition. The lower reaches, which would be utilized as a migrational corridor and for juvenile rearing, are influenced by development and exhibit moderately impaired hydrologic processes. Some TRT members focused on conditions in the upper basin, while others considered conditions in the entire basin.

Spatial structure: Accessibility is good throughout most mainstem reaches. Smaller barriers may exist in the smaller tributaries.

Lower Columbia River Steelhead—Gorge Stratum Winter Run

Lower Gorge Winter Steelhead (Washington)

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	3.00	4.00	3.00	0.00	0.00	1.00	0.00
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	2.83	5.00	2.00	0.17	0.00	0.95	1.17
Habitat	1.83	5.67	2.17	0.33	0.00	1.10	2.17
Spatial structure	2.50	3.67	3.50	0.33	0.00	1.17	1.67

Weighted average: 1.04

Productivity and abundance: TRT members utilized the default “no data” score for steelhead abundance of 3, 4, 3, 0, 0.

JOM: Not rated.

Diversity: There is little information to evaluate the status of population diversity. There have been a number of hatchery introductions, although they are relatively small compared to adjacent tributary basins.

Habitat: Generally poor conditions exist throughout most small Columbia River tributaries that typify this DIP. Some TRT members noted that the total amount of available habitat is relatively small.

Spatial structure: Steelhead have access to a large number of geographically dispersed populations; however, the connectivity within each tributary may be limited due to development and poor habitat patches.

Lower Gorge Winter Steelhead (Oregon)

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	5.25	3.88	0.63	0.25	0.00	0.59	0.25
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	3.63	3.75	2.38	0.29	0.00	0.94	0.50
Habitat	1.14	2.86	4.43	1.43	0.14	1.66	1.29
Spatial structure	2.75	3.00	3.00	1.13	0.13	1.29	0.88

Weighted average: 0.94

Productivity and abundance: There is little abundance information available for this population. ODFW personnel contend that relatively few steelhead are present, both currently and historically.

JOM: Not rated.

Diversity: No life history information is available. There have been a number of hatchery introductions from multiple sources, many outside of the ESU.

Habitat: Conditions in the lower reaches of the small tributaries that characterize this DIP are moderately impaired. The upper reaches contain relatively good habitat, but are inaccessible due to waterfalls found on most tributaries.

Spatial structure: Hatchery weirs on the larger tributaries limit access to a proportionately large area of habitat.

Upper Gorge Winter Steelhead (Washington)

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	3.00	4.00	3.00	0.00	0.00	1.00	0.00
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	3.83	4.83	1.33	0.00	0.00	0.75	1.00
Habitat	1.17	4.83	3.00	1.00	0.00	1.38	1.83
Spatial structure	2.33	3.67	3.00	1.00	0.00	1.27	1.50

Weighted average: 1.07

Productivity and abundance: For these criteria, TRT members used the default no data score of 3, 4, 3, 0, 0.

JOM: Not rated.

Diversity: Other than hatchery introductions, there is little information to evaluate the diversity criteria.

Habitat: Much of the historical habitat was inundated when Bonneville Pool was filled. The remaining habitat is moderately impaired.

Spatial structure: Although much historical habitat is lost, the geographic dispersal of small tributaries provides some protection against catastrophic risks. The laddering of Shipherd Falls increased accessible habitat in the Wind River; however, winter steelhead appear to make limited use of this additional habitat.

Upper Gorge Winter Steelhead (Oregon)

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	4.88	3.88	1.00	0.25	0.00	0.66	0.25
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	4.00	3.63	2.13	0.25	0.00	0.86	0.75
Habitat	1.29	3.43	4.00	1.14	0.14	1.54	1.29
Spatial structure	3.13	2.38	3.00	1.63	0.13	1.38	1.00

Weighted average: 0.96

Productivity and abundance: No abundance data was presented. Most TRT members used the default score; others based their persistence evaluations on personal knowledge or habitat capacity.

JOM: Not rated.

Diversity: Small population size may produce genetic bottlenecks. Hatchery releases may also substantially influence what naturally spawning fish exist.

Habitat: Total available habitat is very small and may limit the population.

Spatial structure: The filling of Bonneville Pool eliminated a proportionately large area of available habitat. A dam on Herman Creek limits access on the largest tributary in this DIP. Small population size also restricts spatial structure.

Hood River Winter Steelhead

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	1.00	3.50	4.38	1.13	0.00	1.56	1.63
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	0.50	3.00	4.38	2.13	0.00	1.81	1.29
Habitat	1.00	4.43	3.43	1.14	0.00	1.47	1.43
Spatial structure	0.50	3.13	4.13	2.25	0.00	1.81	1.43

Weighted average: 1.63

Productivity and abundance: The abundance trend is positive, with average escapement at a few hundred fish. Hatchery-origin fish contribute about half of the run.

JOM: Not rated.

Diversity: The Hood River hatchery stock was reestablished using presumed native fish. Although Big Creek winter steelhead (Southwest Washington ESU) were released for an extended period, they may not have significantly introgressed into the native Hood River population, due to differences in spawning time.

Habitat: Agriculture in the lower basin is a factor in habitat degradation. The TRT discussed the effects of recent glacial catastrophic events.

Spatial structure: Agricultural water diversions and culverts may prevent access to smaller tributaries.

Lower Columbia River Steelhead—Gorge Stratum Summer Run

Wind River Summer Steelhead

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	0.33	3.33	4.67	1.67	0.00	1.77	2.00
Juvenile outmigrants	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diversity	0.33	3.67	4.33	1.67	0.00	1.73	1.33
Habitat	0.33	2.67	3.50	3.50	0.00	2.02	2.00
Spatial structure	0.17	2.83	3.83	2.83	0.33	2.03	1.67

Weighted average: 1.85

Productivity and abundance: The long-term lambda for this population is less than 1; however, many TRT members noted that the short-term trend appears strongly positive.

JOM: Not rated.

Diversity: Hatchery fish comprise a substantial portion of escapement. Genetic analysis suggests that, overall, the level of introgression may be limited.

Habitat: Many TRT members noted that EDT analysis is not available for this basin. Other analyses indicated that conditions are relatively good throughout the basin. Land use factors (timber harvest) may have resulted in some degradation.

Spatial structure: Accessibility is generally considered good, similar to historical levels.

Hood River Summer Steelhead

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	2.13	4.75	2.63	0.50	0.00	1.15	1.75
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	1.88	4.25	3.25	0.63	0.00	1.26	1.00
Habitat	0.86	4.14	3.29	1.57	0.14	1.60	1.43
Spatial structure	1.25	4.00	3.13	1.50	0.13	1.53	0.88

Weighted average: 1.37

Productivity and abundance: Abundance has been low (approximately 250) but stable. A hatchery supplementation program appears to have had limited success in improving escapement.

JOM: Not rated.

Diversity: Hatchery introductions using Skamania Hatchery summer steelhead continued until 1990. The establishment of a hatchery broodstock using native summer steelhead appears to have been accomplished with little influence from Skamania Hatchery fish. The laddering of Punchbowl Falls may allow winter steelhead to utilize areas that previously were accessible solely to summer steelhead.

Habitat: Agriculture degraded much of the lower Hood River basin. The West Fork Hood River recently suffered a series of glacial dam failures that severely degraded much summer steelhead spawning habitat. It is unclear how quickly the habitat will recover.

Spatial structure: Habitat conditions in the West Fork Hood River may limit spawner distribution. Additionally, low population abundance limits the population's spatial distribution.

Upper Willamette River Spring-Run Chinook Salmon

Clackamas River Spring-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	0.75	2.88	4.75	1.50	0.13	1.74	1.63
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	2.25	3.25	3.63	0.88	0.00	1.31	1.50
Habitat	1.13	2.75	4.25	1.88	0.00	1.69	1.43
Spatial structure	0.88	2.63	4.00	2.25	0.00	1.74	1.63

Weighted average: 1.66

Productivity and abundance: Recent abundance estimates are over 2,000 naturally produced adults. Most hatchery-origin fish are removed at North Fork Dam, although there was some uncertainty about the proportion of hatchery fish released above the dam

JOM: Not rated.

Diversity: There was some uncertainty regarding the relationship between the current population and the spring-run Chinook salmon that historically existed in the Clackamas River. Large numbers of fish from the upper Willamette River (Santiam, McKenzie, and Middle Fork Rivers) have been introduced since the 1960s. Changes in spawning timing have been observed over the last 100 years. Regardless of origin, the existing spring run has maintained a low to moderate level of natural production (and local adaptation) for a number of generations.

Habitat: Urbanization and agriculture have resulted in moderate to severe degradation in the lower reaches of the Clackamas River. This part of the basin primarily serves as a migratory corridor for adults, but it may provide rearing habitat for juveniles. Despite timber harvest activities, conditions in the upper basin remain relatively good.

Spatial structure: Passage at North Fork Dam may impede upstream passage or juvenile outmigration. In general, spring-run Chinook salmon access was similar to historical levels, although low population levels probably limit distribution.

Molalla River Spring-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	6.63	3.00	0.38	0.00	0.00	0.38	0.75
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	5.00	3.88	0.88	0.25	0.00	0.64	1.00
Habitat	3.13	4.00	2.50	0.38	0.00	1.01	1.25
Spatial structure	3.88	3.38	2.13	0.63	0.00	0.95	1.13

Weighted average: 0.62

Productivity and abundance: There is very little abundance information available for this population. Recent surveys identified only 52 redds. Only 4–10% of escapement is thought to be naturally produced.

JOM: Not rated.

Diversity: There have been substantial hatchery introductions from other upper Willamette tributaries. The scarcity of naturally produced fish suggests that the native population is effectively extirpated, and there is little opportunity for local adaptation among introduced fish.

Habitat: Much of the habitat is severely degraded, especially in the lower basin. Agriculture and residential or urban development is widespread throughout most of the basin.

Spatial structure: Numerous blockages exist in the basin on smaller tributaries.

North Santiam River Spring-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	5.63	3.75	0.63	0.25	0.00	0.58	1.25
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	3.50	3.63	2.25	0.63	0.00	1.00	1.63
Habitat	3.38	4.38	2.00	0.25	0.00	0.91	1.43
Spatial structure	4.88	4.00	0.88	0.25	0.00	0.65	1.86

Weighted average: 0.71

Productivity and abundance: The abundance of naturally produced fish in the North Santiam is very low (low 100s of fish). Most historical spawning habitat is blocked by Detroit Dam. Conditions in the main stem (flow and temperature) limit recruitment by naturally spawning fish. Approximately 90% of escapement is hatchery-produced.

JOM: Not rated.

Diversity: Considerable hatchery influence followed construction of Detroit Dam and the elimination of much spring-run spawning habitat.

Habitat: There has been considerable development in the lower North Santiam River. Riparian conditions are severely or moderately impaired in most of these reaches. Detroit Dam blocks access to much historical spawning habitat (which is still is fairly good condition). Federal ownership of much of the upper basin may ensure continued maintenance of conditions. Thermal conditions created by the outflow from Detroit Dam results in early hatching for eggs spawned in the mainstem and low overall recruitment. Sedimentation also has depressed reproductive success.

Spatial structure: Detroit Dam eliminated approximately 70% of historical spring-run habitat. Low population abundance further limits this population’s distribution.

South Santiam River Spring-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	4.75	3.50	1.63	0.13	0.00	0.71	1.38
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	2.75	4.25	2.38	0.63	0.00	1.09	1.25
Habitat	2.75	4.38	2.63	0.38	0.00	1.08	1.43
Spatial structure	4.38	3.88	1.50	0.25	0.00	0.76	1.63

Weighted average: 0.84

Productivity and abundance: Spring-run Chinook salmon spawn above and below Foster Dam. Estimates of spawner abundance are most accurate for fish spawning above Foster Dam; however, the adult per redd ratio above Foster Dam indicates relatively poor spawning success. The majority of fish returning are of hatchery origin.

JOM: Not rated.

Diversity: Hatchery fish predominate in the system. Many hatchery introductions came from outside the basin but within the ESU (e.g., McKenzie, Middle Fork, and North Santiam Rivers).

Habitat: Flow and temperature issues were thought to be primary limitations to productivity below Foster Dam. Additionally, riparian conditions in the lower reaches are moderately or severely impaired. Agriculture impacts much of the lower basin. Above Foster Dam, habitat is better but accessibility is limited.

Spatial structure: Impassable dams in the upper basin eliminate access to 80% of historical spawning habitat. Habitat conditions may exclude fish from some lower tributaries.

Calapooia River Spring-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	6.63	2.88	0.50	0.00	0.00	0.39	0.75
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	5.13	3.25	1.13	0.50	0.00	0.70	1.13
Habitat	2.75	4.25	2.63	0.38	0.00	1.06	1.43
Spatial structure	4.00	3.25	1.88	0.88	0.00	0.96	1.13

Weighted average: 0.65

Productivity and abundance: Surveys of the Calapooia River are limited. Available information indicates that adult escapement is consistently low. Snorkel surveys normally identify a few juveniles. The majority of fish observed are probably of hatchery origin.

JOM: Not rated.

Diversity: There have been a number of hatchery introductions into the Calapooia River. Surplus adults from the South Santiam Hatchery have been released in recent years to reestablish a sustainable population.

Habitat: Agriculture degraded much of the Calapooia River basin. Riparian habitat is severely degraded. Temperature and water quality conditions are quite poor.

Spatial structure: A number of dams in the mainstem Calapooia River may present passage problems under certain flow regimes. Habitat conditions may also impair access and distribution. Small population size also limits distribution.

McKenzie River Spring-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	0.13	2.13	5.00	2.75	0.00	2.04	2.25
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	0.50	3.00	4.43	2.00	0.00	1.79	1.43
Habitat	0.75	3.13	4.00	2.13	0.00	1.75	1.57
Spatial structure	1.13	4.50	3.25	1.13	0.00	1.44	1.63

Weighted average: 1.85

Productivity and abundance: Recent estimates suggest that escapement includes 2,000 to 3,000 naturally produced fish. Some, but not all, hatchery fish are blocked from spawning above Leaburg Dam. Below the dam, hatchery fish constitute about 50% of naturally spawning fish.

JOM: Not rated.

Diversity: The McKenzie River Hatchery has released Chinook salmon for nearly 100 years. The broodstock was founded and has been supplemented primarily with local adults.

Habitat: Outfall from Cougar Dam traditionally resulted in deleterious flow and temperature regimes. This situation is currently addressed by a reengineered intake structure. Cougar Dam blocks approximately 40% of historical range. There have been a number of experimental releases into the basin above Cougar Dam, although the TRT concluded that there is insufficient evidence to confirm that these releases contribute to productivity.

Spatial structure: Cougar Dam represents the most significant obstruction to spatial structure.

Middle Fork Willamette River Spring-Run Chinook Salmon

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	6.25	2.75	0.88	0.13	0.00	0.49	1.13
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	2.38	4.00	2.75	0.88	0.00	1.21	1.25
Habitat	4.50	3.50	1.75	0.25	0.00	0.78	1.38
Habitat (w/passage)	*0.00*	*3.00*	*5.00*	*2.00*	*0.00*	*1.90*	*1.00*
Spatial structure	6.38	3.13	0.50	0.00	0.00	0.41	1.38

Weighted average: 0.64

Productivity and abundance: The abundance of naturally produced fish is probably in the low hundreds; nearly 80% of escapement is hatchery-produced. Limited production occurs in Fall Creek and through experimental production above Dexter Dam. A large number of fish spawn below Dexter Dam, but environmental conditions in the river preclude successful reproduction.

JOM: Not rated.

Diversity: This population is primarily sustained through releases from the Willamette Hatchery. The hatchery broodstock was founded by fish from the Middle Fork Willamette River, and still probably contains the genetic legacy of the native population.

Habitat: Except for Fall Creek, the entire historical spawning habitat is behind Dexter Dam. Although ODFW is studying whether to introduce fish into the basin above the dams, most TRT members did not believe these introductions would contribute significantly to population sustainability.

Spatial structure: Dexter and Fall Creek Dams block or impede access to most historical spawning habitat in this basin.

Upper Willamette River Winter Steelhead

Molalla River Winter Steelhead

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	3.13	3.88	2.63	0.38	0.00	1.03	1.29
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	1.13	3.88	4.13	1.00	0.00	1.51	1.29
Habitat	2.13	4.00	3.25	0.63	0.00	1.24	1.43
Spatial structure	1.88	4.38	3.00	0.75	0.00	1.26	1.29

Weighted average: 1.18

Productivity and abundance: TRT members noted a negative long-term trend in abundance, however, recent return years yielded a strong positive trend. Total current abundance is relatively low (hundreds of fish), although recent return years have not been inflated by hatchery supplementation. Hatchery releases were terminated in 1997.

JOM: Not rated.

Diversity: Genetic analysis suggests that hatchery supplementation with nonnative stocks do not impact genetic diversity in this population.

Habitat: Conditions in the Molalla River are generally poor in the lower reaches, with slightly better conditions in the upper watershed. Residential and agricultural land use affects most of the lower basin.

Spatial structure: There are numerous small blockages throughout the basin. Low population abundance further limits the population's spatial distribution.

North Santiam River Winter Steelhead

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	1.00	3.13	3.75	1.75	0.00	1.59	1.25
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	1.25	4.25	3.13	1.38	0.00	1.46	1.50
Habitat	2.13	4.00	3.00	0.75	0.00	1.23	1.63
Spatial structure	2.00	4.38	3.00	0.63	0.00	1.23	1.13

Weighted average: 1.45

Productivity and abundance: Current abundance is approximately 1,000 fish. Abundance estimates are based on a number of index counts. The long-term trend for this population is negative, although this may partly be an artifact of the termination of releases in 1998. Earlier surveys did not distinguish between hatchery and wild fish. The loss of hatchery fish would be detected as a drop in abundance.

JOM: Not rated.

Diversity: Hatchery production of winter steelhead stopped in 1998, although summer steelhead releases continued. Genetic analysis indicates a strong similarity between late-winter steelhead in the upper Willamette basin, suggesting that introductions of steelhead from outside the ESU have had minimal genetic impact.

Habitat: Flow and temperature issues below Detroit/Big Cliff Dam do not affect steelhead to the same degree as Chinook salmon (steelhead spawning more in smaller tributaries). Additionally, riparian conditions in the lower reaches are moderately or severely impaired. Agricultural and residential land use predominates throughout the lower basin.

Spatial structure: Impassable dams in the upper basin eliminated access to 55–65% of historical spawning habitat. Habitat conditions may exclude fish from some lower tributaries.

South Santiam Winter Steelhead

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	0.75	3.25	3.88	1.88	0.00	1.66	1.38
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	1.00	3.88	3.38	1.75	0.00	1.59	1.25
Habitat	2.00	4.38	3.00	0.63	0.00	1.23	1.38
Spatial structure	3.13	3.50	2.75	0.63	0.00	1.09	1.13

Weighted average: 1.48

Productivity and abundance: Recent abundance is near 1,000 fish, with no hatchery supplementation for over a decade. The short-term trend is strongly positive, but primarily influenced by the most recent 2 years of data (possibly related to improving ocean conditions).

JOM: Not rated.

Diversity: There was some concern about possible introgression between introduced summer-run steelhead and native winter-run steelhead. Winter steelhead releases were recently terminated in the Santiam basin. Prior to 1990, a number of steelhead stocks were released, and it is not known to what extent these populations may have interbred. Abundance levels are well above any critical effective population threshold.

Habitat: Flow and temperature issues below Foster Dam do not affect steelhead to the same degree they do Chinook salmon (steelhead spawning more in smaller tributaries). Additionally, riparian conditions in the lower reaches are moderately or severely impaired. Agriculture impacts much of the lower basin. Thomas and Crabtree Creeks were historically good spawning sites. Above Foster Dam, habitat is better but access is limited.

Spatial structure: Impassable dams in the upper basin eliminate access to 80% of historical spawning habitat. Habitat conditions may exclude fish from some lower tributaries.

Calapooia Winter Steelhead

Attribute	0.00	1.00	2.00	3.00	4.00	Average	Data quality
Productivity	1.25	4.13	3.50	1.00	0.00	1.41	1.50
Juvenile outmigrants	NR	NR	NR	NR	NR	NR	NR
Diversity	0.75	3.38	4.25	1.63	0.25	1.78	1.63
Habitat	1.50	4.00	3.75	0.75	0.00	1.38	1.50
Spatial structure	1.50	3.50	3.38	1.63	0.00	1.51	1.38

Weighted average: 1.48

Productivity and abundance: Abundance has been low (in the hundreds) but stable. There was some discussion that spawner surveys may underestimate the abundance. There have been relatively limited introductions into this basin, and natural production predominates.

JOM: Not rated.

Diversity: Most TRT members noted the limited hatchery input. Low abundance levels during the 1990s may have suppressed the effective population size to critical levels. Genetic analysis indicates a close affinity to other native populations in this ESU.

Habitat: Agricultural activities degraded much of the lower Calapooia. Riparian conditions are moderately or severely impaired throughout all but the headwater areas. Temperature and water quality conditions are thought to be quite poor, especially during summer low flows.

Spatial structure: A number of small dams in the mainstem Calapooia River may present passage problems under certain flow regimes. Habitat conditions may also impair access and distribution.